

MONTHLY WEATHER REVIEW,

MARCH, 1881.

(General Weather Service of the United States.)

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In preparing this REVIEW the following data, received up to April 20th, have been used, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 136 Signal Service stations and 15 Canadian stations, as telegraphed to this office; 183 monthly journals and 178 monthly means from the former, and 15 monthly means from the latter; reports from 5 Sunset stations; 255 monthly registers from Voluntary Observers; 62 monthly registers from United States Army Post Surgeons; Marine Records; International Simultaneous Observations; monthly reports from Voluntary Observers in, and the local Weather Services of, Iowa, Nebraska and Missouri, and of the Central Pacific Railway Co.; reliable newspaper extracts; special reports.

BAROMETRIC PRESSURE.

The distribution of mean atmospheric pressure over the United States and Canada for the month of March, 1881, is shown by isobaric lines (in black) upon chart No. II. The area of highest barometer, which has been moving steadily eastward from the Pacific since November, 1880, and which during the following months of December and January was so marked over the central portions of the country, has during the present month passed far eastward over the Atlantic leaving a remarkably low mean pressure over the eastern sections of the country, particularly from the Ohio valley and Virginia northeastward to Maine. The rapidity and extent of this eastward movement is shown quite forcibly on the wind chart by the general and decided northwesterly trend of the winds eastward of the Rocky Mountains. The regions of maximum pressure are to be found along the immediate Gulf and Pacific coasts, where only immaterial changes have taken place during the month. Compared with March, 1880, the pressure of the present month is strikingly at variance, as is shown by the position of the region of highest pressure, which in 1880 occupied the precise region now embraced by the abnormally low pressures of the present month.

Departures from the Normal values for the month.—The region of greatest departure from the normal covers the eastern portion of the Middle Atlantic and New England States ranging from -0.25 at Norfolk to -0.32 at Wood's Holl; along the South Atlantic and East Gulf coasts the departure ranges from -0.05 at Key West to -0.24 at Kittyhawk; over the Lake region from $+0.01$ at Duluth to -0.18 at Toledo and -0.23 at Oswego; in the Ohio valley and Tennessee, from -0.13 at Memphis to -0.21 at Pittsburg; in the Upper Mississippi and Lower Missouri valleys, from -0.02 at Omaha to -0.14 at St. Louis; in the West Gulf States and Texas, from -0.02 at Corsicana to -0.11 at Vicksburg; westward of the Missouri river and northward of Colorado the pressure is from 0.03 to 0.4 above the normal, while the line of no change passes southwestward from Lake Superior in nearly a direct course to Santa Fe, where it bends northward reaching the Pacific coast at the southern boundary of Oregon. Throughout California the pressure fell from 0.03 to 0.06 below the normal.

Barometric Ranges.—The range of pressure during the month has varied in the extremes from 0.35 inch at Key West to 1.42 inches at Boston. Ranges of 1.00 and above were reported from stations in Oregon, Washington Territory, Idaho and southwestern Montana, throughout the Upper Mississippi and Lower Missouri valleys, the southern portion of the Upper Lake region and thence northeastward to Newfoundland. In Tennessee and from North Carolina south and westward the range nowhere reaches above 0.98, except at Fort Gibson, where it records 1.03, while in general it varies from 0.5 to 0.75, with the lowest ranges along the immediate Gulf coast. The range everywhere increases with the latitude, being on the Pacific coast from 0.51 at San Diego to 1.12 at Olympia, and on the Atlantic coast as given above. Along the Gulf coast the range increases gradually from 0.35 at Key West to 0.74 at Brownsville, Tex.

Areas of High Barometer.—Six such areas are described for the month of March, 1881, though only one (No. I) exercised any special influence on the climatic conditions of the country; but the month is remarkable for deficiency in pressure, especially in the Eastern States. On the New England and Middle Atlantic Coast this deficiency ranges from 2.5 to 3 inches, probably the most notable deficiency that has occurred since the establishment of the Signal Service. It is also worthy of note that the minimum temperatures are not, as is the general rule, associated with the areas of high barometer, but in the majority of instances have, in March, occurred after the passage of the centre of low area and after the veering of winds to the northwest, but before the pressure had reached its maximum or risen above the normal.

No. I.—On the 1st there was a great rise in pressure in Washington Territory and Oregon, following an area of low barometer, which on the previous day advanced to the eastward over British Columbia. At the morning observation of the 2nd the following were the highest reported barometers: Olympia, 30.44 or 0.43 above the normal; Portland, 30.48 or 0.41 above the normal; the rise in pressure for one day at these points being respectively 0.54 and 0.46 inches. The winds on the coast continued southerly during this rise, which is frequently the case on the Pacific slope; the rise in pressure appearing to come from the southwest and there is seldom the veering of winds to the northwest, after the passage of the centre of low area, which is so frequent a feature of storms east of the Rocky Mountains. On the 2nd the centre of the area of highest pressure moved slowly to the eastward into Idaho and Utah, but the greatest rise, averaging one-half of an inch, occurred in Colorado. On the 3rd the pressure, slightly yielding, continued above the mean from the Pacific coast to the Mississippi valley, while on the Texas coast there was a considerable rise. Cautionary Off-shore Signals, changed from Cautionary, that had been ordered in advance of low area No. II, were justified by the following maximum velocities: Indianola, 43 N.; Galveston, 32 N. On the 4th the region of highest barometer was transferred to Manitoba. On the 5th there was a general rise in pressure east of the Mississippi river, but the centre of the high area remained in the Lower Missouri valley. On the 6th there was a rise averaging nearly half an inch in the Lower Lake region, and the isobars of high pressure included the Lakes, the Ohio valley and Tennessee. On the 7th the highest area extended from the Lower Lakes to the South Atlantic coast. On the 8th it disappeared in advance of low area No. IV, then moving to the eastward over the Ohio valley. In connection with this high area the minimum temperatures of the month were reported from the Lower Missouri valley, Arkansas, Indian Territory and northeastern Texas on the 5th, and from the Ohio valley to South Atlantic coast on the 5th and 6th.

No. II.—On the 7th the mercury rose in rear of low-area No. IV. On the 8th a slight rise was felt from Missouri to Louisiana. On the 9th the centre of the high area was transferred to the Upper Lakes. On the 10th the high pressure extended over the Lakes. On the 11th the region of pressure above the normal was confined to the vicinity of Lake Superior, and on the succeeding day this ceased to be a distinct high area, disappearing before the advance of low-area No. V.

No. III.—On the 12th and 13th there was a great rise in pressure in the Northwest, Upper Lakes and Ohio valley, succeeding depression No. V, the greatest rises in twenty-four hours being 0.75 inches at Leavenworth and 0.74 inches at Keokuk. On the 14th the high area extended from the Lakes to the Atlantic coast, the greatest rise of mercury occurring in New England. The highest barometer was reported from Pittsburg, 30.33, or 0.3 inches above the normal. On the 15th highest pressure was transferred to the Middle Atlantic and New England coast. At the morning report the barometer in New England and the Middle Atlantic States was in general 0.3 above the normal. On the 16th, with yielding pressure, the high area moved along the South Atlantic coast, and on the 17th disappeared before the advance of a low area in the Ohio valley and Tennessee.

No. IV.—On the 16th there was a marked rise of mercury on the North Pacific coast, which rise on the 17th extended over the Rocky Mountain region and Northwest, the highest barometers being in Washington Ty., and Idaho. On the 18th the highest area continued in Washington Ty., the highest pressure being at Olympia, 30.35, Portland, 30.4, Roseburg, 30.4, or respectively 0.42, 0.41, 0.35 above the normal. On the 19th the barometer was generally above the mean west of the Mississippi river, with the greatest rise in the Gulf States, but the centre of highest pressure continued, as for the several previous days, stationary in Washington Ty. On

the 20th the barometer still continued highest in Washington Ty. On the 21st the region of highest barometer moved eastwardly to Idaho and Montana. On the 22nd the highest area was rapidly transferred to Texas. On the 23rd and 24th it disappeared to the southward as an independent high area, in advance of low area No. IX moving over the Ohio valley. During its regime on the Pacific coast unusually fair weather prevailed from the 18th until the 23rd. On the 18th Cautionary Signals at Galveston and Indianola were changed to Cautionary Off-shore Signals, and were justified by the following maximum velocities: Galveston, 30 NW.; Indianola, 38 N.

No. V.—On the 25th there was a great rise in pressure in the Northwest, thence extending to Texas in rear of low-area No. IX. On the 26th the region of highest pressure reached from the Lakes to the Gulf. Cautionary Off-shore Signals, changed from Cautionary on the Texas coast, were justified at Indianola by the following maximum velocity, 31 N. On the 27th, with rapidly diminishing pressure, the high area was transferred to the Gulf States, where, on the succeeding day, it disappeared before the advance of low-area No. X.

No. VI.—On the 26th a marked barometric rise was reported from the Pacific coast, which rise extended the next day into Idaho and Wyoming. On the 28th the greatest rise occurred in the Northwest, but the region of highest barometer, 0.3 inches above the normal, was in Dakota, Montana and Idaho. On the 29th the greatest rise was in the Southwest, with the pressure generally above the mean west of the Mississippi River, but the highest area remained nearly stationary in the extreme Northwest. On the 30th there was a slight change in the distribution of pressure, but on the 31st a great rise occurred in Manitoba, where at the last report of the day the barometer at Ft. Garry was 30.62, or 0.53 inches above the normal. The following high pressures were also reported: Bismarck, 30.54, or 0.53 above the normal; St. Vincent, 30.57; Moorehead, 30.54. In connection with this high area, whose further history will appear in the April REVIEW, there were ordered Cautionary Northwest Signals at Milwaukee and Grand Haven, and justified as follows: Milwaukee, 26 NW.; Grand Haven, 25 NW.

Areas of Low Barometer.—Nine such areas have had their tracks charted for the month of March, 1881. (No. I not charted.) Of these one (No. V) has its track charted across the continent, finally disappearing beyond the New England Coast. Another depression (No. VII) undoubtedly crossed the continent from the Pacific over Mexico, but not within the limits of the chart. Four (Nos. II, IV, VII and X) exhibited great energy at some portions of their tracks. Five (Nos. III, VI, VII, IX and X) developed within the limits of the United States. One (No. VII) after crossing the continent and leaving the St. Lawrence valley on the 21st, became a permanent low area for the rest of the month in the Maritime Provinces and Nova Scotia; the lowest reported barometer was at Chatham, 28.82 at the afternoon observation of the 27th, which was 1.05 inches below the normal. Two depressions (Nos. VIII and IX) skirted the edge of the great depression (No. VII), but neither developed much energy nor merged with the original low area.

No. I (not charted).—This is a continuation of low-area No. X, described at length in the MONTHLY WEATHER REVIEW OF FEBRUARY. On the last day of February it moved over the Middle Atlantic States and beyond the coast. On the 1st and 2nd the circulation of the winds and fall of the barometer shows that the centre of depression moved slowly but with great energy and in a track nearly parallel to the New England Coast. The following low barometers are noted: Boston, 29.15; Portland, 29.18; both 0.79 inches below the normal. Violent northeast to northwest gales prevailed on the New England Coast. A maximum velocity of 48 NE. was reported from Eastport on the morning of the 2nd, where the storm was the most violent experienced during the season, delaying steamers from 36 to 48 hours, and considerable damage was done in the lower part of the city by the flooding of cellars.

Nos. II & III.—On the 1st a depression moved from the British Possessions in a southeasterly track down the Missouri valley. It was accompanied by a sharp fall of pressure, but no precipitation fell in front of the centre of low area. On the 2nd the storm centre changed its course more to the eastward, entering, at the midnight observation, the Ohio valley; the pressures then reported were at St. Louis, Cairo and Memphis below the normal respectively, 0.5, 0.54, 0.51 inches; at North Platte at 3 p. m., the temperature was 27°, a fall of 36° since the previous day. Snow and sleet were reported from Missouri, Iowa and Wisconsin, with high northeast to northwest winds. On the 3rd, with a great increase of energy, the storm centre moved from the Ohio valley to southern Michigan. The following are the lowest pressures at the hours of tri-daily telegraphic reports: Toledo, 29.25, or 0.7 inches below the normal; Sandusky, 29.31, or 0.69 below the normal. Snow fell generally in the Lake region, Ohio valley and Tennessee, while rain was reported from the South Atlantic States. During the day there was a great fall of temperature in the Gulf States, Tennessee and the Ohio valley, averaging from 20° to 25°. At the morning report of the 4th there were two distinct centres of depression on the map: No. II, as charted, central over Lake Michigan, and No. III, which had been developed by the great fall in pressure in the Middle Atlantic States, in advance of low-area No. II; during the day the centre of depression (No. II) moved slowly over the Lower Lakes. At the midnight report the lowest pressure was at Oswego, 29.3 or 0.69 below the normal. At the morning observation of the 4th

there had been, in twenty-four hours, a fall in pressure at Philadelphia of 0.78 inches and at Baltimore of 0.77 inches, the readings being at each 29.2 or respectively, 0.87 and 0.89 inches below the normal. At this report the circulation of the winds showed the development of a secondary depression central in the Middle Atlantic States with the original depression central over Lake Michigan; during the 4th this depression, moving with diminishing energy in a northerly track, became merged in low area No. II near Lake Ontario. On the 5th and 6th, with greatly diminished energy, the centre of depression moved over New England and beyond the coast. In connection with these areas there were ordered Cautionary Signals on the 1st at Indianola and Galveston, justified by maximum velocities as follows: Indianola, 45 SW.; Galveston, 32 N. Cautionary Northwest Signals on the 2nd at Milwaukee and Grand Haven, justified at Milwaukee by 32 NW. Cautionary Signals on the 3rd from Smithville to Eastport, justified as follows: Smithville, 31 SW.; Hatteras, 38 SE.; Kittyhawk, 29 W.; Cape Henry, 32 E.; Chincoteague, 40 E.; Delaware Breakwater, 50 SW.; Cape May, 40 NE.; Atlantic City, 44 SE.; Barnegat, 49 E.; Sandy Hook, 40 NE.; New York, 42 NE.; New Haven, 29 NE.; New London, 30 E.; New Shoreham, 32 E.; Newport, 26 NE.; Wood's Holl, 32 E.; Boston, 33 NE.; Thatcher's Island, 42 E.; Portland, 28 E.; Eastport, 40 NE. On the 4th Cautionary Signals were changed to Cautionary Off-shore Signals from Smithville to Cape May, and were justified, but the off-shore winds were not as high as the on-shore winds.

No. IV.—On the 5th there was a depression of great extent covering New Mexico, Arizona, California and the northern States of Mexico. At the morning report of the 6th the lowest barometers were in western Texas; during the day the center of low area moved slowly to the eastward. During the ensuing night there appears to have been developed two separate centres of depression, one, as charted, moving to the southeast and disappearing as a low area after the morning of the 7th; the other, pursuing the more usual track to the northeast, was at the midnight report of the 7th central in Missouri. On the 8th the depression moved up the Ohio valley, showing but slight energy, but was accompanied by general rains in the Southern and Middle States, and light snow in the Lake region. At the a. m. report of the 9th the storm centre had moved near Norfolk, with a great increase of energy. During the day the storm moved slowly to the northeast along the coast with increasing violence. The following are the lowest barometers reported: Sandy Hook, 29.4; Barnegat, 29.35; Atlantic City, 29.37; below the normal respectively 0.64, 0.66 and 0.66 inches. On the 10th, with the centre of depression at sea, the storm moved nearly parallel to the New England coast, with the lowest barometer at New Shoreham, 29.43. On the 11th the centre of low area advanced slowly to the northeast nearly parallel to the Maine coast. The following are the lowest reported pressures: Portland, 29.24; Eastport, 29.29; below the normal, respectively, 0.69 and 0.61 inches. On the 12th, remaining nearly stationary in position, the barometer rose at the centre of depression. In its track along the Atlantic coast this storm exhibited very great energy. Cautionary Signals were displayed for this storm on the 8th, from Smithville to Sandy Hook; on the 9th from New York to Eastport. The display was justified by the following velocities: Smithville, 26 S.; Macon, 31 SE.; Hatteras, 36 SW.; Kittyhawk, 32 W.; Cape Henry, 32 W.; Norfolk, 26 NW.; Chincoteague, 40 SW.; Delaware Breakwater, 70 NE.; Cape May, 44 NE.; Atlantic City, 34 NE.; Barnegat, 42 N.; Sandy Hook, 40 W.; New York, 36 NE.; New Haven, 36 NE.; New London, 28 NW.; New Shoreham, 44 NE.; Newport, 32 W.; Wood's Holl, 41 NW.; Boston, 40 NE.; Thatcher's Island, 66 NW.; Portland, 29 NE.; Eastport, 46 E. Cautionary were changed to Cautionary Off-shore Signals on the 9th from Hatteras to Atlantic City, and on the 10th from Barnegat to Portland. These Signals were all justified, both as to direction and as to velocity.

No. V.—This is the only low-area of the month whose centre is distinctly traced across the continent. On the 8th there was a great fall of mercury in Oregon and Washington Ty., the pressure, at the end of the day, averaging, along the coast, one-half inch below the mean. Rains fell generally on this and the succeeding day, as far south as Lower California. On the 9th, pursuing a southeasterly track, the depression advanced into Utah Ty., accompanied by light rain or snow in Idaho and Nevada. On the 10th the low-area became central in western Kansas, and light snow was reported from its north and west quadrants; the lowest barometer at Dodge City was 0.57 inches below the normal. On the 11th, developing greatly increased energy, the storm-centre moved slowly into eastern Kansas, the lowest pressure at Leavenworth, 29.15, was 0.8 inches below the normal. Rain fell this day south of the track of the centre of low area to the Gulf, and snow to the north. On the 12th, with diminished energy, the depression moved to Lake Michigan. At midnight the lowest barometer was at Chicago, 29.5, or 0.35 inches higher than at Leavenworth the previous twenty-four hours. During the day rain fell in all the Southern and Middle States, rain or snow in New England and the Lower Lakes, snow in the Upper Lakes and in the Northwest. On the 13th, with the barometer rising at the centre of low-area, the depression moved with greatly diminishing energy over New England and beyond the coast. Cautionary Signals were displayed for this storm on the 9th at Indianola and Galveston, not justified; on the 10th at Milwaukee and Grand Haven, justified respectively by maximum velocities of 26 NE., 25 E. On the 11th from Mobile to Cape May, on the 12th from Atlantic City to Wood's Holl, generally justified

by the following maximum velocities: Pensacola, 36 S.; Cedar Keys, 40 SW.; Jacksonville, 30 SE.; Savannah, 25 S.; Smithville, 28 S.; Wilmington, 28 SW.; Hatteras, 36 SW.; Kittyhawk, 35 NE.; Cape Henry 28 NW.; Delaware Breakwater, 34 NE.; Cape May, 37 NW.; Atlantic City, 27 SE.; Barnegat, 27 NW. On the New England coast these signals were only justified at New Shoreham by 28 N.

No. VI.—On the 12th and 13th a great depression was developed in Utah and Arizona, the lowest pressures being 0.5 inches below the mean. The position of the storm centre cannot, however, be defined. The low area was accompanied by rain in southern California, southern Nevada and in Arizona, extending on the 13th across the Rocky Mountains into New Mexico and Colorado. On the 14th the depression pursued a northeasterly track over Kansas and Nebraska, the lowest pressure at Omaha, 29.65, being 0.35 below the normal. On the 15th, with diminishing energy, the storm-centre passed over Lake Superior and beyond the limits of the chart. Cautionary Signals were displayed at Milwaukee and Grand Haven on the 14th, and justified at Milwaukee by the following maximum velocity, 34 SW.

No. VII.—The changes in barometric pressure, circulation of the winds and rain-fall in southern California and Arizona on the 15th and 16th, leads to the inference that on those days a depression, moving from the Pacific Ocean, crossed in an easterly track Lower California and Northern Mexico, the centre of low area entering the valley of the Rio Grande at the midnight report of the 17th. On the 18th, with increasing energy, it moved in a northeasterly path over Texas and Arkansas into northern Mississippi, the lowest pressure at Memphis, 29.49, being 0.59 below the normal. On the 19th it moved with increasing violence into southern Michigan. The lowest pressures of the day were at Indianapolis, 29.19, 0.75 below the normal, Port Huron, Chicago and Grand Haven, below the normal 0.72, 0.73 and 0.73, respectively; heavy snow-storms, with high northeast to northwest gales, blocking railway communication, were reported from the Upper Mississippi valley and the Upper Lake region. On the 20th, with diminishing energy, the depression moved over Lake Huron into Canada. The lowest pressure of the day was at the morning report of Grand Haven, 29.19 or 0.79 below the normal. This day the snow extended over the Lower Lake region, where on the previous day rain had fallen. On the 21st, with greatly diminished energy, the centre of depression moved down the St. Lawrence valley. At the midnight report the barometers at Quebec and Father Point were both 0.62 below the normal. Cautionary Signals were ordered on the 18th at Milwaukee and Grand Haven, and on the same day from Smithville to Norfolk. These were fully justified by the following maximum velocities: Milwaukee, 47 N.; Grand Haven, 30 NE.; Smithville, 40 S.; Wilmington, 27 SW.; Macon, 26 E.; Hatteras, 28 E.; Kittyhawk, 28 SW.; Cape Henry, 38 S.

No. VIII.—On the 20th the pressure was below the mean east of the 100th meridian, with the greatest depression in the Lower Lakes and the St. Lawrence valley. At the morning report of the 21st there was shown a slight fall in barometer in western Arkansas, where the circulation of the winds showed the development of a new (or secondary) centre of depression. During the day the low area moved in an easterly track into Georgia and South Carolina, accompanied by rain in the East Gulf States and by snow in Tennessee. On the 22nd it passed over North Carolina and beyond the limits of the chart. During its passage there were some high winds of brief duration on the East Gulf and South Atlantic coasts. Cautionary Signals were ordered for this storm on the 21st from Mobile to Cedar Keys; on the 22nd at Jacksonville and Savannah; north of Savannah signals were still displayed for the previous storm, No. VII. This storm is interesting as the secondary development of an independent low area within a region of low barometer.

No. IX.—On the 24th the fall in mercury and the circulation of the winds show the development of a low area in eastern Colorado and Kansas. On the 25th, with a slight increase in energy, the centre of depression moved into eastern Tennessee, and on the 26th passed over North Carolina beyond the limits of the chart. This storm at no point showed special energy.

No. X.—On the 27th there was a considerable fall of pressure in Colorado, and at the 3 p. m. report the circulation of the winds indicated the development of a low-area in eastern Colorado, which pursued a southeasterly track until the morning report of the 28th, when a trough-like depression, averaging 0.3 inches below the normal, extended from Illinois to western Texas. So far the low-area had been attended by no precipitation to the eastward and by only occasional light rain in its rear. On the 28th, developing considerable increase in energy, the centre of depression moved into the Ohio valley and Tennessee, where the lowest pressures, at Louisville 29.55, and at Nashville 29.64, were respectively below the normal 0.46 and 0.41 inches. On the 29th, with slightly increasing energy, the storm-centre moved to the eastward, with the pressure in general 0.6 inches below the normal in North Carolina at the midnight report. On the 30th the storm-centre changed its direction, moving in a northeasterly track over Maryland, Delaware and New Jersey and also developing greater energy; the lowest barometer at Sandy Hook, 29.04, was 0.99 below the normal. The pressure fell to less than 0.9 below the normal at New London, New York, Philadelphia, Baltimore, Washington, Norfolk and at all stations on the Middle Atlantic coast. On the 31st the depression continued its northeasterly course, with its centre beyond the limits of

the chart; the lowest reported barometer was at Thatcher's Island, 28.96 or more than one inch below the mean. High northeasterly gales prevailed on the New England coast during this and the previous day. Cautionary Signals were ordered for this storm on the 28th at Milwaukee and Grand Haven, only justified at Milwaukee by a maximum velocity of 29 NE.; also ordered on the 28th from Smithville to Cape Henry, and from Chincoteague to Cape May; on the 29th from Pensacola to Charleston, and from Atlantic City to Wood's Holl; on the 30th from Boston to Eastport. These signals were generally justified by the following maximum velocities: Pensacola, 32 NW.; Cedar Keys, 39 NW.; Jacksonville, 42 SW.; Savannah, 32 W.; Charleston, 32 W.; Smithville, 32 SW.; Wilmington, 30 W.; Macon, 28 S.; Hatteras, 58 SW.; Kittyhawk, 55 W.; Cape Henry, 29 W.; Norfolk, 30 SW.; Chincoteague, 40 W.; Delaware Breakwater, 38 SW.; Cape May, 44 W.; Atlantic City, 47 NE.; Barnegat, 52 E.; Sandy Hook, 56 E.; New York, 48 NE.; New Haven, 28 NE.; New London, 27 E.; New Shoreham, 52 NE.; Wood's Holl, 29 E.; Boston, 41 NE.; Thatcher's Island, 65 NE.; Portland, 26 NE.; Eastport, 46 NE. On the 30th, Cautionary Signals were changed to Cautionary Off-shore from Hatteras to Cape May, and on the 31st from Atlantic City to Wood's Holl. These were generally justified both as to direction and as to velocity.

INTERNATIONAL METEOROLOGY.

Two international charts accompany the present REVIEW. No. IV is for the month of February, 1881. No. V is for the month of April, 1877, and is published in accordance with the explanation given in the opening paragraph under International Meteorology in the January, 1881, REVIEW.

Chart No. IV, for the month of February, 1881, indicates, as well as is at present (April 16, 1881,) possible, the general course taken by the most prominent storm-areas over the North Atlantic ocean and adjacent land-areas during that month. The tracks Nos. I, IV and VI are continuations of Nos. I, IV and IX, respectively, of chart No. I for February. Only one (No. I) storm appears to have crossed the Atlantic from the American to the European seaboard, but this is pretty well defined, and, from present indications, was, in all probability, a most severe storm. Originating probably within the area of heavy rains on the Pacific coast, (see MONTHLY WEATHER REVIEW for January, low barometer area No. IX,) it afterwards moved across the eastern half of the United States and western portion of the Atlantic with great rapidity, its progressive velocity, from 8 a. m. to 3 p. m. of the 1st, while traversing Tennessee and North Carolina, averaging 75 miles per hour. In its journey eastward it was marked by a gradually falling barometer and by severe gales, the pressure at the centre of depression, while the storm was over the United States, being about 29.80, while over the central Atlantic it fell to about 29.50 and over the British Isles to about 28.90. On the coast of the Atlantic States the wind reached a velocity of 56 miles per hour at Cape May; in 39 N., 74 W., brig. *Atlas* experienced a furious gale, heavy sea and intense cold, during which the vessel became completely iced up; in 41 N., 54 W., steamer *Rheola* had hurricane with heavy seas sweeping decks. Over mid-ocean the winds decreased somewhat, but as the storm approached the British Isles it was again attended by violent winds. Over the North American continent and western portion of the Atlantic this depression was followed by a period of high barometer and low temperature, which in duration and severity, is almost without precedent. In regard to this, within the limits of the United States and Canada, attention is asked to the description of high areas and to the chapters on *Temperature* in the January and February REVIEWS, while in regard to Central America the following despatch, dated Panama, February 24, 1881, will be read with interest:—"The 10th of February will be remembered in Guatemala as the occasion of a frost, the heaviest within the memory of man, occasioning damage the like of which has no record in the history of the country since its conquest by the Spaniards. Ice formed in many places * * * ; leaves and tender shoots of coffee trees were shrivelled and discolored and sugar canes killed * * *. The amount of damage is estimated to be between one and two millions of dollars. The cold wave seems to have come from the north, apparently traversing the Cordilleras through Mexico and leaving evidences of its effect in various parts of that country before reaching Guatemala." In advance of these high pressures NE'ly high winds and gales were experienced over the western portion of the Atlantic, and at the Bermudas cold weather, with rain or hail squalls, prevailed from the 4th to the 8th, the minimum thermometer at Gibb's Hill Light station on the morning of the 7th registering 51°, which is the lowest temperature experienced at this place, according to the records at hand, since February, 1879. Areas Nos. III and V appear to have originated in or about mid-ocean on the 8th and 13th, respectively. During the passage of No. III over the British Isles the barometer at Mullaghmore fell to 28.48, and on the 13th, (see area No. V,) the barometer on board S. S. *Belgenland*, in 49° N., 25° W., fell to 29.00 during a SW. gale, force 10 Beaufort scale. On the 14th high pressures set in over northern Europe, and apparently formed a barrier to the eastward progress of storm-areas from the Atlantic over the British Isles. By the 20th the barometer had increased to 30.9 over Sweden and northern Russia and the area of high pressure gradually spread eastward, reducing the pressure over the British Isles for the week ending Feb-

ruary 28th to about 7 degrees, Fahrenheit, below the mean. During the regime of the high pressures over North America and northern Europe, the barometer reached 30.91 at Burlington, Vermont, on the 6th and 31.00 at Moscow on the 21st. These maximum readings in connection with the low one (28.48) recorded at Mullaghmore on the 10th give us the large barometric range of 2.52 inches for the month. Low area No. VI, already described as area No. IX in February REVIEW, moved rapidly eastward during the 25th and at the end of the month was central in mid-ocean.

Mr. C. Meldrum furnishes the following notes on cyclones occurring in the neighborhood of Mauritius during the month of December, 1880, and January, 1881. No cyclones were reported during November, the month in which these storms may be first looked for in this region: "From the 15th to the 20th of December, 1880, a cyclone passed north and northwest of Mauritius at a distance of 150 to 200 miles, causing some damage to vessels that put to sea from Reunion. On the 2nd and 3rd of January a hurricane was encountered by the *Berar* in 14° S. and 85° E. From the 10th to the 14th of January a hurricane took place in about 15° S. and 72° E. The *Mairi Bahn* and other vessels were dismasted. A cyclone passed NNW. and west of Mauritius from the 18th to the 21st of January, doing much damage at Reunion on the 21st. Another cyclone passed east and southeast of Mauritius from the 6th to the 13th of February. Information regarding these cyclones is being collected."

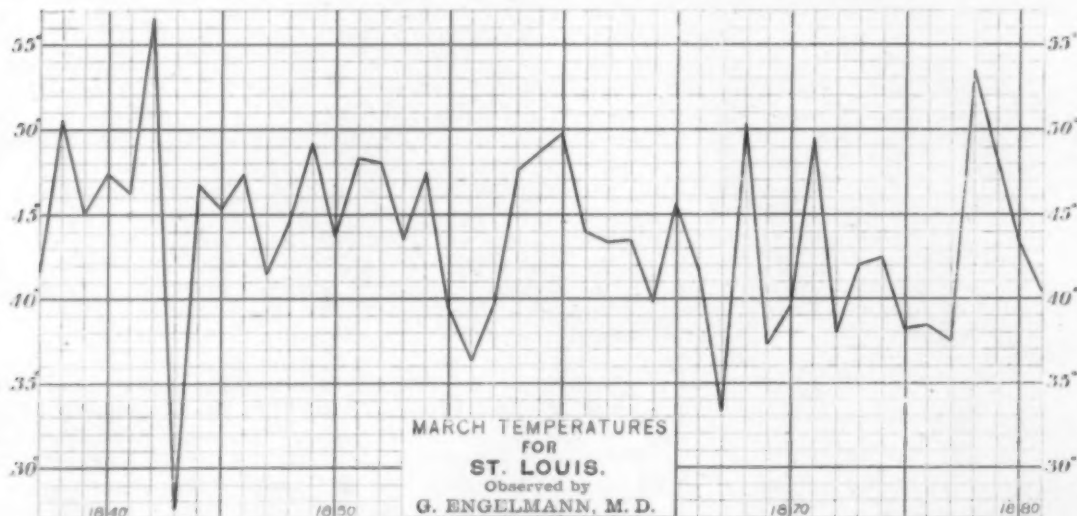
Chart No. V shows the mean pressure, temperature and wind force and the prevailing direction of the wind at 7.35 a. m. Washington, or 0.43 p. m. Greenwich, mean time, for the month of April, 1877, over the northern, and at certain isolated stations in the southern, hemisphere. The area of lowest pressure is still found central over the Atlantic Ocean, but with a decided translation to the southward, and, so far as observations at stations along the seaboard indicate, with a continued increase in pressure. While we found the lowest mean barometer for January to be 29.17 at Stykkisholm, and at Tromso for February and March 29.44 and 29.59, respectively, we now find the lowest means for April, to be 29.64 at Valencia and 29.65 at Brest. The highest monthly mean (30.14) is that of Portland, Oregon, while next in order of pressure comes York Factory (30.12). These give a total monthly range in the mean pressures for the northern hemisphere during April of only 0.5 inch, while those of January, February and March were, respectively, 1.28, 0.94 and 0.65. The changes found by comparing the mean pressures of April with those of March show a very marked and interesting homogeneity, there being only one line of no change. This zero-line, if we trace it eastward, enters the United States in northern California, runs north-eastwardly to Manitoba and thence southeasterly throughout the region of the great lakes and Middle Atlantic States to about the same parallel it had on the Pacific coast; its course then changes toward the northeast, running along the coast of the New England States, through New Brunswick, and apparently leaving the American continent near the Straits of Belle Isle; it reappears upon the European coast in the north of Ireland. After running southeasterly to the Straits of Dover it follows the 50th parallel to central Russia and thence curves northeastwardly to the Obi valley. North of this line the comparisons show a gradual increase in the pressure of April over that of March, the excess at the most northerly stations being, as follows: Esquimalt, +0.15; York Factory, +0.17; Godthaab, +0.32; Stykkisholm, +0.31; Thorshavn, +0.33; Brono, +0.37; Tromso, +0.33, and Archangel, +0.27 inch. Everywhere to the south of this line, except at certain isolated stations near the equator and in the southern hemisphere, there is a decided decrease, which gradually increases to 0.16 inch in the Lower Mississippi valley, to 0.15 at St. John's Newfoundland, to 0.21 at the Azores, to 0.10 at Lisbon and Algiers, to 0.12 at Beirut and Fao, to 0.22 at Nukuss and Yenisseisk, to 0.20 at Pekin and to 0.17 at Shanghai.

TEMPERATURE OF THE AIR.

The mean temperature of the air for March, 1881, is shown by the isothermal lines (in red) on chart No. II. The table of mean and comparative temperatures, in the right-hand corner of the chart, shows in the first column the average for the month throughout the various districts as deduced principally from observations taken at Signal Service stations. In the two remaining columns are shown the means for the present month and the departures of such means from the average for many years. Throughout a majority of the various districts of the country the temperature is below the normal, while in the Upper and Lower Lake regions no change occurs. The departures of excess, ranging from +0.4 in the Southern Plateau to +8.5 in the Northern Rocky Mountain slope, are confined, with a single exception, to the northern sections of the country, or above parallel 40°; those of deficiency, ranging from -0.4 in the Middle Atlantic States to -4.8 in the South Atlantic States, embracing the southern districts, are most marked in the Gulf and South Atlantic States.

Deviations from Mean Temperatures.—Under this heading, departures exhibited by the reports from the regular Signal Service stations are shown in the table of comparative temperatures, on the right-hand side of chart No. II. The following items of importance, in connection with this

subject, were reported by voluntary observers: *Florida*: Month coldest ever experienced. *Illinois*: Riley, mean temperature $3^{\circ}.3$ below the mean of March for the past 20 years; coldest March months occurred in 1866, 1867, 1869, 1872, 1875 and 1877. Morrison, month characterized by a very uniform temperature. Belvidere, mean temperature $3^{\circ}.16$ below mean of past 15 years; coldest March in that period occurred in 1877, mean $23^{\circ}.11$; warmest, in 1878, mean $43^{\circ}.09$; lowest minimum, -20° in 1877; highest maximum, $+75^{\circ}$ in 1875. *Indiana*: Logansport, month very unpleasant, the first and last weeks being especially cold and stormy; temperature considerably below the normal. *Iowa*: Guttenburg, hardest month of March ever experienced in this section of the State. Clinton, month unusually cold and stormy. Marshall, most backward March ever known here. Muscatine, month unusually blustering and cold. *Kansas*: Lawrence, mean temperature $4^{\circ}.34$ below the mean of March for the past 13 years. Holton, coldest March ever experienced here, remarkable continuance of severe northwest winds. Clay Centre, very severe month, storms, gales and unusually cold weather. *Maine*: Gardiner, month very warm, mean temperature $3^{\circ}.87$ above the mean of March for the past 45 years; minimum temperature for the present month, 20° , is the highest ever recorded; mean of the four winter months for the past 45 years $23^{\circ}.08$; this winter (1880-'81) $19^{\circ}.79$ or $3^{\circ}.29$ below. Cornish, month cold and disagreeable. *Maryland*: Fallston, mean temperature $1^{\circ}.6$ below the mean of the past 10 years; minimum temperature for the month 24° , lowest ever recorded for March in the past 11 years, except 1871. *Massachusetts*: South Lee, very cold rough weather throughout the month. *Michigan*: Northport, no signs of spring, very cold and stormy throughout the month. *Missouri*: Frankford, most backward spring ever experienced here, everything retains the appearance of



mid-winter. St. Louis Weather Service reports the mean temperature $4^{\circ}.4$ below the mean of March for the past 45 years; during this period colder months of March have occurred in eight separate years; lowest mean, $27^{\circ}.5$, occurred in 1845; highest mean, $56^{\circ}.7$, occurred in 1837; lowest minimum, 0° , occurred in 1848; highest maximum, 86° , occurred in 1842. The above diagram shows the curve of mean temperatures for March, as furnished by Prof. F. E. Nipher of the "Missouri Weather Service." As compared with the observations taken at the Signal Service stations in St. Louis during the past ten years, the curves appear to be reliable. *New Jersey*: Newark, mean temperature $0^{\circ}.52$ below the mean of March for the past 37 years; warmest March occurred in 1849, mean $46^{\circ}.17$; coldest in 1872, mean $30^{\circ}.23$; highest maximum, 77° , occurred March 28th, 1845; lowest minimum, 2° , March 19th, 1868. *New Hampshire*: Conitocookville, mean temperature $4^{\circ}.6$ above the mean of March for the past 10 years. *New York*: North Volney, mean temperature $2^{\circ}.06$ above the mean of March for the past 13 years. Palermo, mean temperature $2^{\circ}.1$ below the mean of March for the past 28 years. *Texas*: Clarksville, month unusually cold and disagreeable, vegetation very backward. Melissa, month very cold, no signs of spring. *Virginia*: Wytheville, mean temperature, 6° below the mean of March for the past 16 years. *Wisconsin*: Embarrass, month very cold and stormy, everything retains the appearance of mid-winter; such a month of March never before experienced.

Table of Maximum and Minimum Temperatures for March, 1881.

State or Territory.	Signal Service.			U. S. Army Post Surgeons or Voluntary Observers.			State or Territory.	Signal Service.			U. S. Army Post Surgeons or Voluntary Observers.		
	Station.	Max.	Min.	Station.	Max.	Min.		Station.	Max.	Min.	Station.	Max.	Min.
Alabama.....	Montgomery..	76°	34°	Tuscaloosa.....	106°	30°	Missouri.....	St. Louis.....	69°	26°	Booneville.....	80°	.....
Arizona.....	Yuma.....	97°	0°	Texas Hill.....	106°	.....	Do.....	Rock Creek.....	87°	.....	Corning.....	70°	.....
Do.....	Prescott.....	78°	32°	Mt. Ida.....	80°	.....	Montana.....	North Platte.....	71°	3°	Ft. Ellis.....	84°	.....
Arkansas.....	Little Rock.....	85°	23°	Fayetteville.....	101°	18°	Nebraska.....	Winnemucca.....	78°	.....	Lincoln.....	84°	.....
Do.....	Red Bluff.....	85°	23°	Truckee.....	80°	.....	Do.....	Pioche.....	13°	.....	Ft. Hartsuff.....	88°	.....
California.....	Campo.....	89°	15°	Mam'oth Tank.....	76°	20°	Nevada.....	M. Washington.....	35°	8°	Golconda.....	88°	.....
Colorado.....	Denver.....	89°	15°	Pagosa Spr'gs.....	64°	.....	Do.....	Atlantic City.....	56°	.....	Otego.....	88°	.....
Do.....	Pike's Peak.....	84°	22°	Mystic.....	64°	.....	New Hampshire.....	Barnegat.....	21°	.....	Atco and.....	.....	.....
Connecticut.....	New Haven.....	69°	.....	Southington.....	68°	.....	Do.....	Albuquerque.....	92°	.....	Vineland.....	62°	.....
Do.....	Deadwood.....	69°	.....	Ft. Lincoln.....	68°	.....	New Mexico.....	Santa Fe.....	8°	.....	Dodge Mine.....	15°	.....
Dakota.....	Breakwater.....	37°	27°	Ft. Stevenson.....	60°	.....	Do.....	New York City.....	57°	.....	Ft. Union.....	23°	.....
Delaware.....	Washington.....	63°	25°	Dover.....	60°	.....	Do.....	Buffalo.....	.....	.....	.....	.....	.....
Dist. Columbia.....	Key West.....	87°	.....	Houston.....	32°	.....	Do.....	Richester and.....	.....	.....	Madison Ba'ks.....	23°	.....
Florida.....	Pensacola.....	77°	29°	Logan and.....	.....	.....	Do.....	Oswego.....	78°	.....	Highlands.....	12°	.....
Georgia.....	Atlanta.....	77°	29°	Vail.....	0°	.....	Do.....	Wilmington.....	29°	.....	Ruggles.....	10°	.....
Do.....	Keokuk.....	86°	17°	Anna.....	81°	.....	North Carolina.....	Charlotte.....	13°	.....	Fallsington.....	62°	.....
Iowa.....	Dubuque.....	82°	13°	Riley.....	69°	2°	Do.....	Cincinnati.....	63°	.....	Franklin and.....	10°	.....
Do.....	Boise City.....	76°	12°	New Harmony.....	69°	.....	Ohio.....	Cleveland.....	81°	27°	Wellsboro'.....	77°	.....
Idaho.....	Eagle Rock.....	74°	.....	Emporia.....	90°	.....	Oregon.....	Umatilla.....	73°	33°	Aiken.....	20°	.....
Do.....	Cairo.....	74°	.....	Bowl'g Green.....	71°	.....	Pennsylvania.....	Pittsburg and.....	61°	.....	.....	.....	.....
Illinois.....	Chicago and.....	11°	.....	Fallston.....	64°	.....	Do.....	Philadelphia.....	13°	.....	Tusculum.....	20°	.....
Do.....	Champaign.....	62°	18°	Deer Park.....	13°	.....	Do.....	Erie.....	53°	23°	Ft. Elliott.....	18°	.....
Indiana.....	Indianapolis.....	86°	17°	Billericia.....	56°	.....	Rhode Island.....	Newport.....	73°	33°	.....	.....	.....
Indian Ty.....	Fort Supply.....	82°	13°	Williamstown.....	14°	.....	South Carolina.....	Charleston.....	.....	.....	.....	.....	.....
Kansas.....	Dodge City.....	82°	13°	Fayette.....	80°	33°	Do.....	.....	.....	.....	.....	.....	.....
Do.....	Leavenworth.....	65°	22°	.....	.....	.....	Tennessee.....	Nashville and.....	76°	.....	.....	.....	.....
Kentucky.....	Louisville.....	51°	36°	.....	.....	.....	Do.....	Memphis.....	23°	.....	.....	.....	.....
Louisiana.....	Shreveport.....	51°	36°	.....	.....	.....	Do.....	Knoxville.....	.....	.....	.....	.....	.....
Maine.....	Portland.....	50°	27°	.....	.....	.....	Texas.....	Uvalde and.....	83°	.....	.....	.....	.....
Do.....	Eastport.....	50°	27°	.....	.....	.....	Do.....	Rio Grande.....	.....	.....	.....	.....	.....
Maryland.....	Baltimore.....	50°	27°	.....	.....	.....	Do.....	El Paso.....	.....	.....	.....	.....	.....
Do.....	Boston and.....	53°	20°	.....	.....	.....	Utah.....	Salt Lake City.....	75°	25°	.....	.....	.....
Massachusetts.....	Springfield.....	53°	20°	.....	.....	.....	Vermont.....	Burlington.....	47°	16°	Charlotte.....	53°	.....
Do.....	Thatcher's Id.....	53°	20°	.....	.....	.....	Do.....	Cape Henry.....	73°	.....	.....	.....	.....
Michigan.....	Detroit.....	53°	20°	.....	.....	.....	Do.....	Norfolk and.....	73°	.....	.....	.....	.....
Do.....	Alpena.....	51°	.....	.....	.....	.....	Do.....	Lynchburg.....	73°	.....	.....	.....	.....
Minnesota.....	Duluth.....	51°	.....	.....	.....	.....	Do.....	Chincoteague.....	71°	29°	Wytheville.....	13°	.....
Do.....	St. Paul and.....	51°	.....	.....	.....	.....	Washington Ty.....	Olympia.....	71°	29°	.....	.....	.....
Do.....	St. Vincent.....	51°	.....	.....	.....	.....	West Virginia.....	Morgantown.....	64°	25°	Helvetia.....	60°	14°
Mississippi.....	Vicksburg.....	78°	36°	.....	.....	.....	Wisconsin.....	La Crosse.....	47°	.....	Embarras.....	10°	.....
Do.....	.....	78°	36°	.....	.....	.....	Do.....	Milwaukee.....	47°	.....	Ft. Fetterman.....	76°	8°

Ranges of Temperature at Signal Service Stations.—Monthly ranges in general varied from 30° to 50° over the country east of the Rocky Mountains, and from 40° to 60° to the westward of that region. Ranges less than 40° occurred in the following regions: throughout the Middle Atlantic States and New England, in the Lower Lake region, along the North Carolina and Gulf coasts, at scattering stations in the Ohio valley and along the California coast. The *smallest* ranges were: Woods Holl, 23°; New Shoreham, 24°; Port Huron, 25°; Galveston, 26°; Cape May, New London and Newport, 28°; Indianola, Boston and Eastport, 29°; Portland, Me., Thatcher's Island, Delaware Breakwater, Springfield, Mass., and Milwaukee, 30°. The *largest* were: Fort Verde, 79°; Prescott, 78°; Rock Creek, Dak., 77°; Fort Craig, N. M., 74°; Silver City, 70°; Dodge City and Fort Supply, 69°. The *daily* ranges varied in the different districts as follows: New England, from 15° at New Shoreham to 26° at New Haven and 25° at Springfield; Middle States, 18° at Cape May to 32° at Lynchburg; South Atlantic States, 23° at Portsmouth to 32° at Augusta and Kittyhawk; Eastern Gulf States, 18° at Key West to 35° at Montgomery; Western Gulf States, 18° at Galveston to 31° at Shreveport and Vicksburg and 38° at Little Rock; Ohio valley and Tennessee, 24° at Columbus to 36° at Knoxville; Lower Lake region, 19° at Detroit to 26° at Oswego; Upper Lake region, 17° at Chicago to 35° at Duluth; Upper Mississippi valley, 25° at Keokuk to 34° at St. Louis and 36° at Dubuque; Missouri valley, 26° at Omaha to 34° at Fort Buford and 38° at Leavenworth; Red River of the North valley, 39° at St. Vincent to 43° at Moorehead; Texas, 29° at Brownsville to 51° at Brackettsville and 53° at El Paso; Eastern Rocky Mountain Slope, 36° at Deadwood to 45° at Dodge City and 58° at Fort Supply; Rocky Mountains, 33° at Denver to 36° at Eagle Rock and 38° at Santa Fe; Southern Plateau, 20° at Shakespeare to 53° at Prescott and 57° at Fort Craig; Middle Plateau, 28° at Salt Lake City to 34° at Pioche and Boise City and 41° at Winnemucca; northern Plateau, 30° at Helena to 57° at Missoula and Fort Shaw and 58° at Rock Creek; Southern Pacific Coast region, 24° at San Diego to 52° at Campo; Middle Pacific Coast region, 21° at San Francisco to 32° at Red Bluff; Northern Pacific Coast region, 28° at Portland to 34° at Roseburg.

Frost—was reported very frequently during the month from stations north of the 38th parallel and east of the 114th meridian. Beyond these boundaries, to the south and west, it occurred in the various States on the following dates: central and southeastern Virginia, 6th to 8th, 15th, 21st, 22nd, 24th, 29th; eastern and southern North Carolina, 1st, 2nd, 4th to 11th, 21st, 23rd, 24th,

27th, 28th, 31st; South Carolina, 7th, 21st, 23rd, 27th, 28th; Georgia, 1st, 2nd, 4th to 10th, 20th to 24th, 27th to 31st; northern Florida, 6th, 7th, 22nd, 23rd, 27th; Alabama, 1st, 4th, 6th, 10th, 22nd, 23rd, 27th, 30th, 31st; Mississippi, 1st, 5th, 6th, 9th, 10th, 20th to 24th, 27th, 29th, 30th, 31st; Louisiana, none reported; Arkansas, 1st, 6th, 9th, 10th, 20th, 22nd, 23rd, 27th; Texas, 3rd, 4th, 5th, 8th, 16th, 19th to 23rd, 27th, 30th, 31st; Indian Territory, 8th, 9th, 20th, 22nd, 23rd, 26th, 30th; southern New Mexico, 3rd, 4th, 6th, 7th, 11th to 22nd; southern Arizona, 4th, 8th, 11th to 14th, 18th to 27th; southern California, 1st, 4th, 5th, 6th, 11th, 12th, 15th, 16th, 17th, 19th, 21st, 26th, 27th; at Visalia very heavy frost occurred on the night of the 11th, causing considerable injury to peaches, almonds and figs; at the foot-hills and on the plains nearly all apricots were killed; northern California, 10th, 11th, 12th, 13th, 14th, 16th, 17th; at Red Bluff, on the 13th, 14th and 16th, very heavy frosts occurred, seriously injuring all kinds of fruit in the low-lands and slightly those on the up-lands; Oregon, 2nd, 5th, 6th, 9th, 10th to 17th, 23rd; Washington Territory, 3rd, 6th, 10th, 14th, 15th, 16th.

Ice—in the northern and central sections of the country is fully considered elsewhere in the REVIEW under the head of "*Ice in Rivers and Harbors.*" Its occasional formation in some of the Southern States and along the southern Pacific Coast is reported as follows: Vicksburg, 23rd; Fayette, Miss., 22nd, 23rd; Campo, 11th; Los Angeles, 17th; Benecia Barracks, Cal., 14th; Princeton, Cal., 14th, 16th; Magnolia, Miss., 31st.

PRECIPITATION.

The general distribution of rain-fall (including melted snow) for March, 1881, is shown on chart No. III, from the reports of over 500 stations. From the table in the left-hand corner of the chart is obtained a monthly average for each of the various districts, determined from the records (covering a period of many years) of Signal Service stations, and also a comparison of the present month with such averages. The regions of heaviest precipitation are to be found along the immediate coast of Washington Territory, throughout Alabama and Georgia, in western North Carolina, and from northern New Jersey eastward along the coast of Connecticut and Rhode Island, and thence northward on the Massachusetts coast to Maine. The regions of least precipitation occupy western Montana, southwestern Wyoming, northwestern Utah, northern Nevada, central New Mexico and southwestern Arizona. As compared with the mean of past years, the rain-fall for the present month is in general below the average, only five districts out of a total of seventeen reporting an excess. Departures of excess range from +0.15 in the Eastern Gulf States to +1.67 in New England; those of deficiency, from -0.1 in the Upper Mississippi valley to -4.94 in the Northern Pacific Coast region. The rain-fall of the Rocky Mountain and Plateau districts is quite uniform in the various sections, but the range for the whole territory (from 0.00 to 4.95 inches,) though considerable, is not unusual.

In connection herewith the following notes from voluntary observers may be of interest: Riley, Ill., monthly rain-fall 4 inches above the average for March during the past 20 years; largest, 6.5 inches, March, 1877. Belvidere, Ill., monthly rain-fall 1.9 below the average for past 13 years; largest, 6.13 in 1876; smallest, 0.79 in 1873. Lawrence, Kan., monthly rain-fall 0.57 below the average for past 13 years. Gardiner, Me., monthly rain-fall 1.41 above the average of the past 45 years. St. Louis, the Missouri Weather Service reports the monthly rain-fall at the central station as 0.27 below the average for the past 45 years; largest amount, 8.61 in 1865; smallest, 0.79 in 1853. The Nebraska Weather Service reports the monthly rain-fall as about normal in the eastern part of the State, but considerably above in the western part. Newark, N. J., monthly rain-fall 3.02 below the average for the past 37 years; largest amount, 10.00 in 1876; smallest, 0.98 in 1854. Patterson, N. J., monthly rain-fall 16.11; heaviest since 1836. Waterburg, N. Y., monthly rain-fall 0.07 above the average for the past 9 years. North Volney, N. Y., monthly rain-fall 0.65 below the average for the past 8 years. Palermo, N. Y., monthly rain-fall 0.3 below the average for the past 28 years. Wytheville, Va., monthly rain-fall 1.6 below the average for the past 16 years.

Special Heavy Rains.—8th and 9th, Woodstock, Md., 3.25; Sandy Springs, Md., 2.55. 9th, Wilmington, N. C., 2.79; Baltimore, 3.51; Ft. Myer, Va., 2.58. 9th and 10th, New London, 3.69; Fallston, Md., 3.20; New Haven, 3.22; Mystic, Conn., 3.00. 11th and 12th, Mobile, 4.11. 15th, Auburn, Ala., 2.49. 15th and 16th, Tuscaloosa, Ala., 5.08. 16th and 17th, Forsythe, Ga., 5.35; Augusta, Ga., 3.88; Atlanta, Ga., 5.35; McPherson Barracks, 5.15; Aiken, S. C., 3.20. 18th, Tuscaloosa, Ala., 3.90; McPherson Barracks, 3.15; Fayette, Miss., 3.00. 19th, Paterson, N. J., 5.23 in 10 hours. 19th and 20th, Flushing, N. Y., 2.40; New Haven, 3.16; Somerville, N. J., 2.87; Ft. Columbus, N. Y., 2.64. 20th, Thatcher's Island, 2.61. 30th, Newport, R. I., 2.92.

Largest Monthly Rain-falls.—Patterson, N. J., 16.11 inches; Neah Bay, Wash. Ty., 12.05; Tuscaloosa, Ala., 11.74; Atlanta, Ga., 10.98; New Haven, 10.42; Mobile, 10.41; Forsyth, Ga., 10.00; Thatcher's Island, 9.96; Boston, 9.86; McPherson Barracks, Ga., 9.04; Mt. Washington, 8.51; Newport, R. I., 8.24; Ft. Stevens, Or., 8.18; Somerville, N. J., 8.12; White Plains, N. Y., 8.10; South Lee, Mass., 8.07; Elsworth, N. C., 7.88; Lawrence, Mass., 7.78; Baltimore, 7.59; Ft. Canby, Wash. Ty., 7.58; Auburn, Ala., 7.57.

Smallest Monthly Rain-falls.—Helena, Mont., Grierson's Springs and Ft. Brown, Tex., none; Yuma, Ariz., and Ft. Elliott, Tex., trace; El Paso, Tex., 0.01 inch; Deer Lodge, Mont., 0.02; Albuquerque, N. M., 0.04; Stockton, Tex., and Ft. Mojave, Ariz., 0.06; Rio Grande and Socorro 0.07; St. Vincent, Dak., 0.08; Ft. Bridger, Wy. Ty., and Browns, Nev., 0.13; La Mesilla, 0.14; Ft. Shaw, Mont., Golconda and Beowawe, Nev., 0.15; Ft. Custer, Mont., and Ft. Griffin, Tex., 0.17; Ft. McDermit, Nev., 0.18; Brownsville and Ft. Concho, Tex., and Wadsworth, Nev., 0.20; Mammoth Tank, Cal., 0.22; Santa Maria, Tex., Carlin, Nev., and Texas Hill, Ariz., 0.24; Hot Springs, Nev., and Promontory, Utah, 0.25; Ft. Davis and Laredo, Tex., 0.27; Ft. Pembina and Ft. Totten, Dak., 0.28; Ft. Benton, Mont., and Indianola, 0.29; Ft. Craig, and Ft. Union, N. M., and Humboldt, Nev., 0.30; Ft. Keogh, Mont., 0.31; Cheyenne, Eagle Pass, Carson City, Nev., and Coalville, Utah, 0.32; Ft. Stevenson, Dak., 0.34; Tehama, Cal., 0.36; Ft. Lincoln, Dak., and Battle Mountain, Nev., 0.40; Ft. Wallace, Kan., 0.42; Umatilla, 0.44; Halleck, Nev., and Bismarck, 0.45; Key West, Washakee, Wy. Ty., and Point San Jose, Cal., 0.46; Ft. Missoula, Mont., and Pioche, 0.47; Rock Creek, Mont., and Ft. Garland, Col., 0.48; Galt, Williams and Indio, Cal., and Dodge City, Kan., 0.50.

Rainy Days.—The number of days on which rain or snow has fallen varies as follows: New England, 11 to 25; Middle Atlantic States, 11 to 19; South Atlantic States, 9 to 15; Eastern Gulf States, 3 to 13; Western Gulf States, 9 to 11; Ohio valley and Tennessee, 15 to 22; Lower Lake region, 16 to 23; Upper Lake region, 9 to 18; Upper Mississippi valley, 8 to 15; Missouri valley, 9 to 11; Red River of the North valley, 6 to 11; Texas, 0 to 8; Rocky Mountains, 5 to 12; Middle Plateau, 3 to 10; Southern Plateau, 1 to 11; California, 1 to 8; Oregon, 5 to 21; Washington Territory, 11 to 20.

Cloudy Days.—The number varied in New England from 10 to 24; Middle Atlantic States, 8 to 20; South Atlantic States, 5 to 12; Eastern Gulf States, 4 to 11; Western Gulf States, 6 to 9; Ohio valley and Tennessee, 6 to 21; Lower Lake region, 13 to 21; Upper Lake region, 10 to 16; Upper Mississippi valley, 10 to 18; Missouri valley, 8 to 11; Red River of the North valley, 5 to 9; Texas, 1 to 13; Rocky Mountains, 4 to 10; Middle Plateau, 3 to 8; Southern Plateau, 0 to 5; California, 0 to 6; Oregon, 9 to 14; Washington Territory 5 to 10.

Rain or Snow from a Cloudless Sky.—Bismarck, 18th.

Snow.—In several instances snow has fallen at points having a more southern latitude than occurred during the past month of February. In California, Arizona and New Mexico it fell along the extreme southern boundaries; in western Texas it was reported from near latitude 30° on the 20th, and in the northern part of the State as low as latitude 35° on the 18th, 19th and 20th; in Arkansas below latitude 35° on the 21st; in Georgia near latitude 33° on the 21st, 22nd, 29th, 30th, and on the North Carolina coast near latitude 35° on the 5th. In the various districts north of parallel 35° it fell on the following dates: *New England*, 1st to 6th, 11th to 21st, 23rd, 24th, 27th to 31st; *Middle Atlantic States*, 1st, 3rd, 4th, 6th, 12th, 13th, 14th, 23rd to 27th, 30th, 31st; *Tennessee*, 3rd to 6th, 20th to 24th, 29th to 31st; *Ohio valley*, 1st to 7th, 11th, 12th, 13th, 19th to 25th, 29th to 31st; *Lower Lake region*, 1st to 7th, 12th to 15th, 20th to 31st; *Upper Lake region*, 1st to 8th, 12th to 21st, 24th, 27th to 31st; *Upper Mississippi valley*, 1st to 8th, 11th to 25th, 27th to 31st; *Minnesota*, 1st to 8th, 12th to 17th, 24th, 28th to 31st; *Missouri valley*, 1st to 16th, 18th to 22nd, 25th to 31st; *Indian Territory*, 3rd, 4th, 18th, 19th, 20th, 21st; *Rocky Mountains*, 1st to 18th, 28th; *Southern Plateau*, 5th, 6th, 9th, 10th, 13th to 20th; *Middle Plateau*, 1st, 5th, 11th to 18th; *Northern Plateau*, 1st, 2nd, 4th, 5th, 7th, 9th to 18th; *California*, Campo, 13th, 16th, 17th; *Visalia*, 14th; *Red Bluff*, 9th, 10th; *Ft. Bidwell*, 4th, 8th, 9th to 12th, 14th, 15th; *Northern Pacific coast region*, 4th, 9th, 11th to 14th, 16th, 18th.

Largest Monthly Snow-falls.—Mt. Washington, 80 inches; Cisco, Cal., 56; Emigrant Gap, Cal., 54; Rockford, Ill., 47; Pikes Peak, 44; Geneseo, Ill., 39; Riley, Ill., 37; Belvidere, Ill., and Bellefontaine, Ohio, 34; Sterling, Ill., and South Lee, Mass., 33; Elmira, Ill., and Clinton, Iowa, 31; Bloomfield, Wis., and Strafford, Vt., 30; Helvetia, W. Va., 29; Deer Park, Md., 27; North Lewisburg, Ohio, 26; Alta, Cal., and Northport, Mich., 25; Yosemite, Cal., Manitowoc, Wis., Frankford, Mo., Hector, N. Y., Ruggles and Cleveland, Ohio, and Woodstock, Vt., 24; Logansport, Ind., Antrim, N. H., and Battle Creek, Mich., 23; Waterburg, N. Y., and Cincinnati, 22; Niles, Mich., Ashley, Mo., and New Castle, Pa., 21; Ashland, Wis., Morrison and Peoria, Ill., Wabash, Ind., Independence, Iowa, Wooster, Ohio, Wellsboro, Pa., and Lunenburg, Vt., 20.

The following items regarding the remarkably severe snow-storms of the month will be found of interest. Before proceeding with details, it will be well to observe that the storms of the 2nd to 4th and 19th to 22nd were the principal ones of the month; their severity, which was extreme, has not been exceeded during the present winter, and in many localities westward, for the past 25 years. *Illinois*: Riley, 2nd to 4th, terrible storm; snow heaped into enormous drifts, all communication cut off until 4 p. m. of the 7th; 19th, worst storm ever experienced; 18 inches fell in 26½ hours; no travel of any kind until 4 p. m. of the 22nd; churches and schools closed and all business suspended. *Morrison*, month remarkable for heavy snow storms, the injury to business being exceed-

ingly severe. Belvidere, 2nd and 3rd, very heavy storms; all roads impassable until the afternoon of the 7th; no mails for five days; nothing like it ever experienced in this section before; 19th, more violent storm; churches and schools closed and all business suspended, no communication until the 24th; "this March will long be remembered as the month of snow blockades." Chicago, 2nd, heaviest storm that ever occurred in this region, traffic of all kinds almost entirely suspended; street-car companies estimate their loss at \$20,000; over 200 tons of mail-matter accumulated for want of transportation; 4th, blockade continued, only eight car-loads of freight received in past 24 hours; five heavy railroad engines acting together, not sufficient to open the heavy drifts; cattle and hogs suffering dreadfully. Waukegan, 4th, public schools closed; snow-drifts up to the second-story window of houses, and still no abatement. Freeport, 40 car-loads of stock shut up in snow-banks west of station; heaviest storm ever experienced here. *Indiana*: Laconia, 29th and 30th, remarkably heavy snow-storm; all roads blockaded and business suspended. New Corydon, 29th and 30th, heaviest storm for years, snow two feet deep on the level; all roads blockaded and traveling impossible. *Iowa*: Vail, 26th, very heavy storm, all roads blockaded; 31st, all communication still closed. Clinton, storms of the 2nd and 3rd, and 19th and 20th, caused the worst interruption to travel ever experienced in this section; no mails or travel from the 2nd to the 6th, and again from the 19th to the 25th; street-cars could not run a single day during these periods. Davenport, 3rd, very heavy storm, all communication cut off; 11th, all roads again blockaded; 19th, more violent storm, business of all kinds nearly suspended. Dubuque, 2nd, heavy snow, trains blockaded; 3rd, snow drifting badly; 4th, heavy snow, all trains delayed; 7th, blockade opened; 11th, heavy snow, trains again blockaded; 19th, very heavy storm, all communication cut off; 21st, blockade opened. Sioux City, 3rd, all roads within 200 miles of station blockaded, some of them since New Years. *Minnesota*: St. Paul, 4th, all roads blockaded; 11th, roads again impassable; 21st, very violent storm, all communication cut off. St. James, 19th, heaviest snow-storm ever experienced in this section, all roads blockaded. Windom, 31st, severest storm of the season, all roads blockaded; on the open prairie snow 2 to 3 feet deep on the level. *Michigan*: Marquette, 1st to 7th, all roads blockaded with snow, no mails until the 8th; 20th, very heavy storm, roads blockaded with enormous drifts, travel of every kind impossible; 31st, all communication again cut off by huge drifts. *Ohio*: Westerville, 28th to 31st, heaviest storm of the season, all roads blockaded and business suspended. Wooster, 28th to 31st, most remarkable storm ever experienced here; snow-fall, 17 inches; all business closed. West Salem, 31st, an uninterrupted storm for the past 70 hours, snow two feet deep on the level; all business suspended. *Pennsylvania*: Erie, 28th to 31st, heaviest storm of the season; roads blockaded. *Wisconsin*: Embarrass, 2nd to 4th, heaviest snow-storm ever experienced here; roads impassable; several times during the remainder of the month severe storms, accompanied with much drifting, cut off all communication for a number of days at a time. La Crosse, 3rd and 19th, very heavy storms, all roads blockaded. Milwaukee, 4th, heavy snow, continuing since the 2nd; all railroad lines closed, business entirely suspended; all country roads impassable and much suffering for want of food and fuel. Oshkosh, 3rd, worst storm ever known in this section, snow drifted almost mountain high; dwellings, sheds and outhouses buried in snow; in many instances drifts were formed on the north side of buildings, reaching over the roofs to the south side, and again, only the chimneys could be discerned protruding from the peak of some immense drift. Madison, 4th, heavy storm, continuing since the 2nd, roads and streets filled with heavy drifts, and quite impassable; city completely isolated, being cut off from communication with every surrounding point. Elroy, 19th, severest storm of the season; all roads blockaded.

Snow on Ground at end of Month.—North of the 25th parallel the following depths in inches were reported in the various States and Territories: *Maine*, 2 to 7; *New Hampshire*, trace to 40; *Vermont*, trace to 24; *Massachusetts*, 2 to 5; *Connecticut*, trace to 2; *New York*, trace to 24; *New Jersey*, trace to 30½; *Pennsylvania*, trace to 15; *Maryland*, trace to 28; *West Virginia*, 1 to 10; *Ohio*, 3 to 29; *Kentucky*, ¾ to 2½; *Tennessee*, 1 to 5; western *North Carolina*, trace to 2; *Indiana*, 1 to 25; *Michigan*, lower peninsula, ½ to 60; upper peninsula, 4 to 42; *Illinois*, 1½ to 20; *Wisconsin*, ½ to 30; *Missouri*, trace to 1; *Iowa*, trace to 24; *Minnesota*, 2 to 6; *Dakota*, 2 to 8; *Nebraska*, trace to 6; *Colorado*, trace to 31½.

Hail.—No storms of marked severity were reported, but frequent falls, with hail-stones of small size, in most cases accompanying thunder-storms, were observed as follows: Rio Vista, Cal., 9th; Poway, Cal., 16th; Wabash, Ind., 3rd; Clinton, Ia., 2nd; Monticello, Ia., 2nd, 11th, 16th; Yates Center, Kan., 15th; Gardiner, Me., 4th; Deer Park, Md., 12th; Fallston, Md., 12th, 30th; Owings Mills, Md., 12th; Sandy Springs, Md., 30th; Woodstock, Md., 29th; Somerset, Mass., 30th, 31st; Westborough, Mass., 30th; Hudson, Mich., 3rd, 21th; Kalamazoo, Mich., 2nd; Thornville, Mich., 3rd; Marshall, Mich., 12th; Fayette, Miss., 18th, stones size of buck-shot, path five miles wide, no damage; San Diego, 16th; Portland, Or., 9th, 11th, 12th; Umatilla, 12th; Fort Canby, Wash Ty., 11th, 12th; Lewiston, Idaho, 12th; Salt Lake City, 9th; Boise City, 3rd; Albuquerque, N. M., 5th; Santa Fe, 6th, 9th; Fort Cummings, N. M., 9th; Ft. Lapwai, Idaho, 11th; Silver City, N. M., 5th, 10th; Dodge City, 2nd, 10th; Fort Gibson, 15th; Pensacola, Fla., 21st; Indianola, 25th; Mobile, 29th.

RELATIVE HUMIDITY.

The percentage of mean relative humidity for the month ranges as follows: New England, 68 to 77; Middle Atlantic States, 54 to 77; South Atlantic States, 54 to 80; Eastern Gulf States, 55 to 70; Western Gulf States, 57 to 71; Ohio Valley and Tennessee, 57 to 72; Lower Lake region, 76 to 81; Upper Lake region, 73 to 82; Upper Mississippi valley, 63 to 75; Missouri valley, 65 to 75; Red River of the North valley, 74 to 85; Texas, 33 to 73; Middle Plateau, 29 to 65; Southern Plateau, 27 to 49; California, 60 to 73; Oregon, 64 to 76; Washington Territory, 70 to 82. *High stations* report the following percentages not corrected for altitude: Pike's Peak, 65.7; Santa Fe, 48.7; Cheyenne, 52.9; Denver, 56.2; Mt. Washington, 86.3.

WINDS.

The prevailing winds during the month of March, 1881, at Signal Service Stations, are shown on chart No. II, by arrows which fly with the wind. Throughout the country, east of the 97th meridian, the winds, with hardly an exception, were from *west to northwest*. Throughout the Rio Grande valley *southeasterly*. Along the Eastern Rocky Mountain Slope *north to northwest*. In central Texas and the Plateau regions, *variable*. In the Middle and Southern Pacific coast regions, *northerly*, and in the Northern Pacific coast region, *southerly*.

Total Movements of the Air.—The following are the largest total movements at the Signal Service stations: Mt. Washington, 20,547 miles; Pike's Peak, 18,620; Cape May, 16,243; Delaware Breakwater, 15,132; Portsmouth, 13,575; Cape Hatteras, 13,479; Chincoteague, 13,168; New Shoreham, 12,451; Wood's Holl, 12,397; Sandy Hook, 12,294; Barnegat, 12,136; Champaign, Ill., 12,100; Kittyhawk, 11,997; Eastport, 11,499; Philadelphia, 11,174; Sandusky, 11,152; Cape Henry, 10,906; Dodge City, 10,590; Indianola, 10,422; Punta Rassa, 10,394; Ft. Myer, Va., 10,339; Cheyenne, 10,326; Cedar Keys, 10,298; New York City, 9,848; Ft. Macon, N. C., 9,847; Boston, 9,826; Decatur, Tex., 9,622; Atlanta, Ga., 9,548; St. Louis, 9,528. The *smallest* are: La Mesilla, 1,603 miles; Phoenix, 1,992; Roseburg, 2,132; Lewiston, 2,182; Florence, 2,531; Ft. Missoula, 2,542; Visalia, 2,863; Deadwood, 2,971; Tuscon, 3,231; Uvalde, 3,462; Olympia, 3,472; Bismarck, 3,614; Portland, Or., 3,656; San Antonio, 3,666; Lynchburg, 3,733.

High Winds.—Winds of 50 miles and over were reported as follows: On summit of Mount Washington, 1st to 4th, 9th, 10th, 19th, 20th, 23rd to 31st; on seven of these dates the wind reached a velocity of 100 miles or over; maximum wind velocity, 132 miles NW., on the 27th. On summit of Pike's Peak, 1st, 2nd, 4th, 15th, 20th to 22nd; maximum wind velocity, 64 miles NW. on the 1st. Thatcher's Island, 66 NW., 11th; 65 NE., 30th. Sandusky, 54 NW., 30th. Barnegat, 52 E., 30th. Cape May, 52 NW., 1st; 51 NW., 2nd; 50 NW., 26th, 27th. Kittyhawk, 52 NE., 26th; 55 W., 31st. New Shoreham, 52 NE., 30th. Cape Hatteras, 58 SW., 30th. Dodge City, 55 NW., 2nd; 56 NW., 11th. Delaware Breakwater, 50 SW., 4th; 70 NE., 9th. Portsmouth, N. C., 72 SW., 30th.

Local Storms.—Near Fayette, Jefferson Co., Miss., 18th, 2:30 p. m., violent tornado passed from SW. to NE., a distance of about five miles; width of storm-track about 100 yards, over which every moveable object was swept away. The Natchez and Jackson railroad bridges across Collet's and Ball's Creeks were nearly demolished, cutting off communication for several days. This tornado developed in connection with the passage of low-area No. VII northeastward from the Rio Grande valley across the northwestern portions of the States of Louisiana and Mississippi. On the afternoon of the 18th cold northwesterly winds prevailed to the northward of the low-area, in Arkansas, Indian Territory and Missouri, while to the southward along the western Gulf coast, opposing warm southerly winds obtained, presenting a contrast in temperature of from 20° to 30°. Galena, Cherokee Co., Kan., 16th, a. m., most violent storm that has ever visited this section. In its appearance it was described as very similar to the terrible tornado that devastated Marshfield, Mo., in April, 1880. Direction of storm path SW. to NE., width of track about 300 yards. Every moveable object in the storm's path was carried away with irresistible force, but fortunately its course was turned aside from the more densely populated portion of the city, which prevented very serious disasters. This tornado developed in the southwest quadrant of an area of low barometer, described as No. VI, on chart No. I. On the afternoon of the 16th, this low pressure extended from the Lower Missouri valley northeastward to the Upper Lake region. In rear of this area cold northwesterly winds, with snow, prevailed, opposed in the West Gulf States by warm southerly winds, which presented a contrast in temperature of from 20° to 30°. Sumterville, Sumter Co., Ala., 23rd, 5 p. m., very violent tornado passed a little north of station. Direction of storm-path SW. to NE.; width of track about 40 yards. Several large buildings and many outhouses, stables, &c., were demolished. Heavy objects were transported considerable distances, and in some instances chickens were carried over a quarter of a mile. The appearance of the storm-cloud was described as fearful, resembling huge volumes of black smoke ascending and whirling in the form of a funnel, accompanied in its passage by a heavy rumbling noise. This tornado developed in connection with the passage of low area No. VIII over the northern portion of the South Atlantic and Eastern Gulf States. After the immediate passage of this low area to the

eastward, cold northwesterly winds prevailed to the northward of Alabama, while in the southern portion of the East Gulf States warm southerly winds obtained, showing a contrast in temperature of from 15° to 20°.

VERIFICATIONS.

Indications.—The detailed comparison of the tri-daily indications for March, with the telegraphic reports for the succeeding twenty-four hours, shows the general percentage of verifications to be 85.3 per cent. The percentages for the four elements are: Weather, 86.7; Direction of the Wind, 82.7; Temperature, 87.4; Barometer, 84.5 per cent. By geographical districts they are: for New England, 86.2; Middle States, 88.7; South Atlantic States, 89.5; Eastern Gulf States, 86.4; Western Gulf States, 86.6; Lower Lake region, 84.7; Upper Lake region, 78.4; Tennessee and the Ohio valley, 86.3; Upper Mississippi valley, 81.7; Lower Missouri valley, 84.8; Northern Pacific coast region, 90.9; Central Pacific coast region, 86.5; Southern Pacific coast region, 94.6. There were 124 omissions to predict (55 being due to the absence of reports from the Pacific coast) out of 3,813 or 3.36 per cent. Of the 3,689 predictions that have been made, 165, or 4.47 per cent, are considered to have entirely failed; 130, or 3.53 per cent, were one fourth verified; 369, or 10.00 per cent, were one-half verified; 361, or 9.78 per cent, were three-fourths verified; 2,664, or 72.22 per cent, were fully verified, so far as can be ascertained from the tri-daily reports.

Cautionary Signals.—218 Cautionary Signals were displayed during the month, of which 199, or 91.3 per cent, were fully justified by winds of 25 miles per hour or over at, or within a radius of 100 miles of, the station. 130 Off-shore Signals were displayed, of which 99, or 76.2 per cent, were fully justified; 121, or 93.1 per cent, justified as to direction; 104, or 80.0 per cent, justified as to velocity, and 4, or 3.1 per cent, completely failed. 90 of the Off-Shore and 2 of the "Northwest" Signals were changed from Cautionary. Six "Northwest" Signals displayed on the Lakes were fully justified. 354 Signals of all kinds were displayed, of which 304, or 85.9 per cent, were fully justified. The above does not include signals ordered at display stations where the velocity is only estimated. 71 winds, of 25 miles or over, were reported, for which no signals were ordered. Fourteen signals were ordered late.

NAVIGATION.

Stage of Water in Rivers.—In the table on the right-hand side of chart No. III are given the highest and lowest stages of water, as observed on the Signal Service river-gauges, during the month of March, 1881. The principal rivers draining the Eastern Rocky Mountain Slope and those falling into the Atlantic and Gulf of Mexico from the South Atlantic and Eastern Gulf States have been subjected to high, rapid and dangerous rises during the month. The Red and Arkansas rivers reached their highest stages between the 1st and 7th, the former approaching within two feet of the danger-line. The Missouri, from Yankton to Leavenworth, reached its maximum stage between the 26th and 29th, reaching the danger-line at Omaha on the 27th. The Mississippi from La Crosse to St. Louis, reached its highest stage between the 26th and 31st; from Cairo to Memphis, between the 1st and 3rd, at the former station rising to 11 inches above the danger-line, and at the latter station to within 17 inches of it; from Vicksburg to New Orleans, between the 8th 17th, rising 10 inches above the danger-line at the former station and to within four inches of it at the latter. In the Ohio, Cumberland, Monongahela and Tennessee rivers the highest stage was reached between the 20th and 26th. At Augusta on the Savannah, the water on the 18th rose to 32 feet, 4 inches, the highest point since 1865. The Willamette at Portland, Or., reached its maximum stage on the 3rd.

Ice in Rivers and Harbors.—The following items, relative to the formation or continuation of ice in such bodies of water throughout the northern sections of the country, exhibit the same for the month of March, 1881. The Missouri has broken up throughout nearly the whole of its course, as well as most of its tributaries, but the Mississippi at St. Paul and northward, still remains frozen. At all lake stations the ice has broken up and moved out, leaving navigation open and boats in many instances have been running regular trips. *Tongue River.*—Fort Keogh, 2nd, ice broke up and passed out; but little damage done. Miles City, 2nd, ice broke up and gorged at a point two miles above the city; water rose rapidly, flooding the streets to a depth of three feet; people left their houses in boats or whatever else would serve to float them; men were seen building boats and sawing and splitting wood on the house-tops. In several instances gorges were blown up with powder and dynamite; one gorge formed having a length of seven miles; damage to property very severe. *Yellowstone River.*—Ft. Keogh, 2nd, ice broke up and passed out causing no damage. Miles City, 2nd, river clear of ice, but water very high. *Little Missouri River.*—Deadwood, 25th, ice broke up during the night and passed out causing no damage. *Big Cheyenne River.*—Deadwood, 25th, ice broke during the afternoon; river gorged at several places. *Big Horn River.*—Ft. Custer, 2nd, ice broke up and passed out during the day. *Des Moines River.*—Ottumwa, 29th, ice gorge broke, filling the river with large quantities of heavy ice, which passed down the stream with resistless fury, carrying everything before it; wagon bridge, consisting of five iron spans, was destroyed entailing a loss of from \$8,000 to \$10,000; considerable damage to merchandise and warehouses along the banks of the river, and several

cellars flooded along Main street. Eddyville, 29th, gorge broke during the afternoon, damaging considerable property, water flooded some of the principal streets to a depth of four feet. Buena Vista, 26th, heaviest ice-gorge ever seen at this point; broke up during the evening, when the water fell 10 feet; railroad bridge seriously injured. Red Rock, 29th, ice gorging very heavily, causing the water to flood everything in vicinity; 30th gorge passed out. *Platte River*.—North Bend, 25th, ice breaking up and forming heavy gorges along the river for miles. *Loup River*.—Columbus, 26th, large quantities of heavy floating ice passed into the Platte, destroying an immense amount of property along the river. *North Fork River*.—Duncan, 25th, ice broke up and passed down into the Platte, carrying away telegraph poles and all property along the banks. *Maquoketa River*.—Logan, Ia., 14th, river free of ice. *Wapispinicon River*.—Independence, Ia., 29th, ice passed out causing no damage; ice on mill pond 34 inches thick and still firm. *Republican River*.—Clay Centre, Kan., 3rd, ice broke up at 3 p. m., carrying away six bridges at various points along the stream. *Rock River*.—Beloit, Wis., 31st, river open by gradual melting and wearing away of the ice. *Mississippi River*.—Moline, Ill., 31st, ice broke up during the morning and piled in huge mountains along the shore to the height of from 18 to 40 feet; the Keokuk Northern Line dock and warehouse valued at \$4,000 was entirely demolished, and the Diamond Jo freight house together with several cars destroyed; Warsaw, 29th, gorge passed out this morning; river clear between here and Keokuk. Keokuk, 16th, ice forced up by rapidly rising water, portion of gauge carried away; 20th, river breaking up in places; 21st, gorge breaking up; 22nd, river rising, ice moving out slowly, all clear around gauge; 23rd, ice gorging and breaking up; 24th, 3.50 p. m., ice moving slowly; 6 p. m., gorged opposite lower part of city; 25th, 10 a. m., moving slowly; 4 p. m., carried away a portion of draw-bridge; 26th, 2.15 p. m., channel clear opposite main part of city, but still gorged near the lower portion; 27th, main channel filled with floating ice at intervals, Illinois side closed; 28th, gorge at Pattersons' Dyke and the ice along the Illinois side broke up and moved through a slough above Tow Head Island, Illinois side now open, but river still closed and ice gorged across Tow Head Island; 29th, last gorge broke at 5 p. m., river now entirely open, channel, filled at intervals with floating ice; 30th, navigation open, steamer "Josie," (first boat of season,) departed for St. Louis, heavy floating ice in channel; 31st, steamer "Arkansas," from St. Louis, first arrival, light flow of ice in channel. Davenport, 31st, ice broke up in the Rapids, gorging between the Water Works and government bridge, water rising to within three feet of the highest point reached last summer, ice two to three feet thick. Old steam boat men state that this is the first time they ever saw the river solid from Davenport, the foot of the Rapids, to Le Claire, the head of the Rapids, hardly a single air-hole was visible the whole distance of 18 miles, even the channels through the "Chains" (Moline chain, Campbell's chain, Sycamore chain, &c.) which have never been frozen over before in their memory, were solid with ice. The present ice gorge is reported to have been the most destructive since that of the 10th of March, 1868, which was the worst ever known along this portion of the Mississippi River. Burlington, 28th, ice in river moving slowly in large fields; 29th, ice breaking up and slowly passing down without any material damage; 30th, river nearly free of ice; 31st, light flow of ice, navigation would be resumed but for a gorge still intact a few miles below the city. La Crosse, 26th, ice breaking up in the Mississippi; Black River now open near its mouth; 27th, river observations resumed, ice broken away from gauge; considerable floating ice in channel. St. Louis, 1st, gorge-ice running down from the Illinois River, which is breaking up very rapidly; 2nd, river full of large fields of heavy ice from broken gorges in the Illinois and Missouri rivers; 3rd and 4th, light ice on the Illinois side; 5th, river clear; 6th, light ice; 7th, clear; 9th and 10th, light ice on the Illinois side; 11th, river clear; 14th, light drift-wood and ice; 15th, full of heavy gorge-ice, mingled with drift-wood; 28th, ice and drift-wood; 29th, clear. Clinton, Ia., 31st, ice in river 24 to 26 inches thick and perfectly solid; water 10 feet 7 inches above low-water mark, having risen to that point within the last four days. This rise has broken the ice loose from the shore, but it remains immovable. *Missouri River*.—Yankton, 29th, ice breaking up and forming huge gorges; 30th, gorges broke during the evening causing a loss of about \$100,000, principally to railroad and steamboat property. The town of Green Island, opposite Yankton, entirely swept away, every building being broken up or floated off by the ice. All steamers moored along the river above Yankton are seriously damaged, and those near by are total wrecks. Signal Service Observer at Yankton reports afternoon of the 29th, gorge 8 miles long, water rising with great rapidity, great loss in horses and cattle. Sioux City, Ia., 30th, water rising rapidly, ice breaking up; 31st, ice gorged from this point westward to Springfield, Dakota, a distance of about 70 miles. Vermillion, Dakota, 31st, huge gorge extending up and down the river for miles; ferry-boat a total loss; much other damage to property. Bismarck, 29th, ice broke up during night; 30th, gorged for miles below the city, at many points forming a solid mass of ice reaching to the bed of the river; great loss to railroad property. The power of huge ice-cakes that forced their way through the woods is shown by the fact that cottonwood trees two feet in diameter were easily cut down by them. Ft. Lincoln, Dak., 30th, ice-gorge immovable, water rising rapidly; all buildings opposite the Fort carried away; several persons rescued from blocks of ice, many cases of indescribable suffering. Ft. Pierre, Dak., 31st, ice terribly gorged, water rising rapidly; great loss of stock and other property,

much suffering among the people. Mandan, Dak., 31st, ice six feet deep all over the town and very solidly packed; no one can reach a point within three miles of the city because of the huge belt of broken ice surrounding it. Omaha, 26th, river gorged near the U. P. R. R. bridge; 27th, gorge broke and ice passed out without any serious damage; the Missouri now open at this point. Ft. Benton, 4th, river opened about 1 p. m., water rose above banks, carrying with it immense cakes of ice; people obliged to leave their houses for places of safety. Iowa City, 31st, ice breaking up and forming heavy gorges, causing much damage to railroad and other property. Leavenworth, 11th, river gorged; 12th, no signs of breaking up; 13th, broke up and moved down about a half-mile; 14th, gorge moved out rapidly, carrying away the river-gauge; 15th and 16th, river full of floating ice; 26th and 27th, full of heavy ice, occasionally gorging; 28th, river clear; 29th and 30th, heavy floating ice; 31st, river clear. Ft. Yates, Dak., 27th, ice broke up at 2 p. m. and passed out rapidly. Council Bluffs, 27th, ice broke up during the morning; 28th, gorged in several places, river rising rapidly. Corning, Mo., 23rd, ice broke up at 3 p. m.; 24th, gorged at several points, water rapidly rising. Oregon, Mo., 15th, ice breaking and moving out; no damage reported. *Maumee River*.—Toledo, 11th, ice-gorge breaking up; 14th, ice slowly running out; 16th, river and harbor partly open, allowing tugboats to run freely between the grain elevators. *Grand River*.—Lansing, Mich., 28th, ice broke up and began to move out; no damage reported. *Black River*.—Port Huron, 19th, ice breaking up; 20th, river open, ferry-boats made regular trips. *St. Clair River*.—Port Huron, 23rd, navigation open to St. Clair, first boat arrived from Marine City; 24th, heavy floating ice; 25th, ice bridge at Point Edwards broke away; 26th, large fields of ice floating down; 27th, light flow of ice; 28th, gorged at head of river; 29th, gorge partially broken; 30th, gorge passed out, river nearly clear; 31st, river clear. *Detroit River*.—Detroit, 20th, river clear of ice; 30th, floating ice in considerable quantities; 31st, river clear. *Lake Erie*.—Buffalo, 31st, except a short, narrow opening, the ice in lake outside of breakwater is still solid as far as the eye can reach. Cleveland, 18th, first arrival of boat on the Ohio Canal; Canal nearly free of ice; 19th, ice in lake broken up by heavy southeasterly winds; mouth of Cuyahoga River open, though along the lake shore the ice is still solid; 24th, schooner "Selkirk" left for Kelly Island, first departure of the season; tug "Myrtle" arrived from Sandusky, first arrival by lake; 30th, an immense field of ice moving toward the city and as far as the eye can reach it appears to be one solid, unbroken mass; 31st, lake covered with ice as far as can be seen, harbor completely closed. Sandusky, 8th, ice in bay rotting; 13th, ice moving slowly; 15th, ice broke into large fields and moved a short distance from docks; tug "Myrtle" arrived from Cleveland, first of season; 16th, ice near docks again solid; 19th, bay clear of ice, being driven out by heavy winds; first time clear since November 20th, 1880; 24th, tug "Myrtle" left for Cleveland, first departure of season; 25th, tug "C. L. Johnson" arrived from Cleveland; 29th, bay full of floating ice; 30th, high winds filled the bay again with ice, which has frozen solid, steamer R. B. Hayes fast in ice, had to be cut out. Toledo, 24th, lake clear of ice, tug-boats running freely about in the harbor. *Lake Ontario*.—Oswego, 30th, schooner "Marcia" sailed for Toronto, first vessel out on the lake, very rough weather experienced, with considerable ice; 31st, large fields of floating ice in lake. Rochester, 26th, lake navigation considered to be practically resumed. *Niagara River*, Buffalo, 21st, ice broke up, tug-boats passed through; 24th, river partially clear; 27th, river entirely clear. *Long Island Sound*.—New London, 1st, ice banked up along the shore, filling the slips along the docks and seriously impeding navigation; 28th, thin ice formed in slips, harbor full of shipping since the 26th. Flushing, 4th, navigation open, propeller "Lloyd" forced her way through the ice; 5th, heavy floating ice; 6th, clear of ice; 25th, 26th, thin ice formed; 27th, entirely open. *Penobscot River*.—Bangor, 11th, ice breaking up and moving out, gorging in the afternoon; 12th, 13th, ice moving gradually in large fields; 15th, ice moving towards mouth of river; 18th, river free of ice, navigation resumed; 26th, 28th, thin ice formed during the night. The following list shows the dates of closing and opening of navigation at the port of Bangor for the past ten years: Opened, 1871, March 13th; 1872, April 19th; 1873, April 19th; 1874, April 16th; 1875, April 16th; 1876, April 18th; 1877, March 20th; 1878, April 2nd; 1879, April 24th; 1880, April 6th; 1881, March 18th. Closed: 1871, November 30th; 1872, December 10th; 1873, December 1st; 1874, December 12th; 1875, November 29th; 1876, December 10th; 1877, December 30th; 1878, December 19th; 1879, December 19th; 1880, November 26th; 1881, November 26th. *Contoocook River*.—Contoocookville, N. H., 20th, ice breaking up and passing down without damage. *Pine River*.—Wellsboro, Pa., 20th, ice broke up and passed out, no damage reported. *Lake Champlain*.—Charlotte, 31st, ice breaking up and moving slowly. *Hudson River*.—Albany 11th, ice opposite lower part of city moved about 200 feet, opening channel between Albany and Greenbush, enabling ferry to resume regular trips; 16th, navigation resumed to-day, river free of ice, tug "C. S. Maury" arrived from Troy; 17th, first tow of loaded canal boats left to-day; 19th, ice gorge between Stuyvesant and lower Kinderhook Light, broke up during the night, river now open to New York City; 21st, tow-boat Ontario arrived from New York city with 40 loaded canal boats, first of season. Poughkeepsie, 10th, river now open from Albany to New York city. Ardenia, N. Y., 11th, ice broke up and passed out, no damage reported.

Floods.—The month of March has been a memorable one along the region bordering the Missouri river in Montana, Dakota and Nebraska, where the heaviest and most destructive floods,

(due to the sudden and general breaking up of the ice,) for many years, have occurred. In Nebraska, the valleys of the Platte and Loup rivers have suffered loss of property almost without precedent. In Kansas, the central and western portions of the State have been subjected to considerable loss of property. In Alabama and Georgia, from the operation of a different cause, viz: heavy rains, much damage has been inflicted. *Alabama*.—Selma, 24th, river highest since 1865, surrounding country under water, great damage to property. Tuscaloosa, 25th, Black Warrior river rose 63 feet, causing great destruction of property along its course. Finches, 21st, Black Warrior river highest ever seen here, water nearly a foot deep in the warehouses. Greensboro', 24th, highest water for several years, streets flooded, much loss to agricultural property. Demopolis, 24th, river highest ever seen, surrounding country partially under water, considerable destruction to property. Gainesville, 24th, Tombigby river above its banks; rose 10 feet during the night, city partially flooded; people leaving their houses and suffering great loss in household property. Centreville, 24th, Catawba river overflowed, much damage to property in the country, bridges, fences and buildings washed away. Eufala, 24th, Chattahoochee river overflowed, all boats laid up and business suspended, several bridges carried away, all bottom lands flooded. Montgomery, 21st Alabama river highest for 15 years, heavy washouts along the various railroad lines, bridges and telegraph poles carried away; in the city the damage has been considerable, on the west side of Court street leading out by the Alabama warehouses, several houses were completely surrounded by water, reaching nearly to the second-story windows; people in this vicinity passed from place to place in boats or upon floating planks; the depth of water in the main channel of the river was variously estimated from 75 to 90 feet. *Texas*, 31st, Texas river overflowed; the Mobile and Montgomery railroad track for a distance of three miles washed away, much other damage to railroad property; all transfers of freight now made by boat from Mobile to Texas bridge, delaying traffic very seriously. *Dakota*.—Bismarck, 30th, Missouri river overflowed, water on the bottom lands several feet deep, many buildings washed away, together with large quantities of hay and other property, 40 head of cattle drowned, several lives lost and many narrow escapes; steamboat property and government warehouses suffered severely. Yankton, 29th, Signal Service observer reports, morning of the 29th, river rose five feet in past 10 hours, country 40 miles to the eastward, overflowed to a depth of three feet and a width of two miles, railroads submerged, all roads impassable. *Florida*.—Houston, 17th to 21st, heaviest rains for years, surrounding country flooded, Suwannee river highest for past 40 years, corn rotting in the ground, crops generally suffering because of excessive moisture. *Georgia*.—Augusta, 17th, very heavy rains, streams rising rapidly; 18th, river highest since 1865, upper portion of city submerged. The City of Hamburg, S. C., partially inundated. *Kansas*.—Seward, 18th, West Blue river overflowed, submerging the country for a distance of several miles; wagon-bridge at Beaver Crossing carried away; considerable damage to other property. Stockton, 19th, Big Creek overflowed; several bridges carried away; horses and cattle drowned; heaviest flood since 1867. Rome, 18th, town completely submerged; buildings and bridges washed away. Hays, 19th, country for miles about, covered with water; considerable property destroyed. *Nebraska*.—North Bend, 27th, Platte river overflowed, submerging the country for a distance of 15 miles on either side; two miles of railroad track swept away; bridges, telegraph-poles, workshops and all buildings and fences in the vicinity of the river destroyed; the town flooded to a depth of several feet, compelling the inhabitants to take flight for safety; all communication of every kind cut off. Columbus, 27th, Loup river inundated the whole lower portion of city; damage to private property immense; wagon-bridge, valued at \$50,000, carried away; railroad-bridge on the Black Hills road destroyed; several lives lost. The Platte valley, for a length of about 100 miles, subjected to the most disastrous flood ever experienced in the history of the State; houses, barns, fences, bridges and stock have been carried away in large numbers, entailing a loss estimated at over \$500,000. Benton, 27th, entire surrounding country covered with water to a depth of several feet; buildings, bridges and fences swept away; cattle have been drowned in large numbers and several human lives lost; over half the bridges in this section of the State destroyed and numerous grist mills washed away. Columbia, 27th, a large body of water several miles in width, formed, surrounding the town, driving the people from their homes and compelling them to pass about in boats or upon floating pieces of timber; destruction to property immense. St. Paul, Howard Co., 27th, surrounding country flooded; all country bridges swept away; railroad bridge on the St. Paul branch of the Union Pacific Railroad washed out. Oreopolis, 27th, the Burlington and Missouri Railroad bridge, over the Platte river, washed away; all telegraph lines down and county submerged for miles. Clarksville, 27th, all bottom lands flooded and several miles of the Union Pacific Railroad tracks washed away. Lincoln, 27th, city completely flooded by the overflow of Salt Creek; people floating about in boats or upon pieces of timber; portion of city deserted. North Platte, 12th, heavy washouts on the Union Pacific Railroad; trains delayed and abandoned. Dunca, 27th, surrounding country flooded to a depth of several feet; people compelled to flee from their houses for places of safety; highest and most destructive flood that ever visited this section of the State. Fremont, 26th, whole city flooded to a depth of several feet; considerable damage to household property and merchandise; Union Pacific Railroad suffered great loss from washing away of tracks, culverts and other property. Schuyler, 27th, town submerged to a depth of ten feet; all houses deserted; people placed themselves and personal effects into freight-

cars, preparatory to deserting the city; many were compelled to cling to the debris of buildings for safety until rescued. Genoa, 27th, town flooded to a depth in many places of 13 feet; river filled with dead cattle, hogs and horses, the debris of bridges, buildings, farm-machinery and lumber; several houses completely covered with water on the bottom lands south of the town. *New York*.—Rochester, 20th, Genesee river overflowed; considerable damage to buildings near the Lower Falls; all the bottom lands for several miles under water. *Maryland*.—Baltimore, 9th, very heavy rain, flooding a portion of city, causing considerable damage to property; serious land-slides on B. & P. R. R., wrecking a train. *Texas*.—Pilot Point, 11th, very heavy rains; all streams overflowed; railroad bridge over Elm Creek carried away; roads almost impassable.

High Tides.—New York City, 30th, unusually high tide, causing great damage to property at Rockaway Beach and Coney Island. Little Egg Harbor, N. J., 4th. New London, 1st; 4th, remarkably high; 31st. Bangor, Me., 11th. New Haven, 4th, remarkably high; many of the wharves covered and the meadows of the Quinnipiac valley completely submerged.

Low Tides.—New River, N. C., 23rd.

TEMPERATURE OF WATER.

The temperature of water, as observed in rivers and harbors at Signal Service stations, with the average depth at which observations were taken, is given in the table on the left-hand side of chart No. III. Owing to ice and breakage of instruments, observations are wanting as follows: Alpena, Burlington, Vt., Cleveland, Chicago, Duluth, Grand Haven, Milwaukee, Marquette, San Francisco, 1st to 31st; Punta Rasa, 1st to 6th; Augusta, 18th to 22nd; Sandusky, 1st to 19th, 30th, 31st; Detroit, 1st to 17th, 30th, 31st; Buffalo, 1st to 27th; Toledo, 1st to 23rd.

ATMOSPHERIC ELECTRICITY.

Thunder-storms.—In the various districts they were reported on the following dates: New England, 1st, 2nd, 16th, 20th; Middle Atlantic States, 3rd, 4th, 9th, 12th, 13th, 16th, 19th, 20th, 29th, 30th, 31st; South Atlantic States, 3rd, 18th, 19th, 22nd, 25th, 26th, 29th, 30th; Eastern Gulf States, 3rd, 7th to 9th, 11th, 12th, 13th, 16th to 19th, 21st, 25th, 26th, 29th; Western Gulf States, (excluding Texas,) 7th, 10th to 12th, 14th to 19th, 21st, 25th, 28th, 29th; Texas, 6th to 11th, 15th to 18th, 24th, 25th, 28th, 29th; Ohio valley and Tennessee, 2nd, 3rd, 11th, 12th, 16th, 18th, 19th, 25th, 28th, 29th; Upper Mississippi valley, 2nd, 11th, 14th to 16th, 25th; Lower Missouri valley, 1st 2nd, 9th, 10th, 14th to 16th, 25th; Arkansas and Indian Territory, 6th, 9th, 10th, 11th, 14th, 15th, 18th, 24th; New Mexico and Arizona, 8th, 9th; Nevada, Carson City, 31st; California, Red Bluff, 9th, 20th, Yosemite valley, 31st; Oregon and Washington Territory, along the valley of the Willamette, 1st, 23rd, 26th. No thunder-storms were reported from the Lake region, the Northwest or Rocky Mountain regions.

Auroras.—In general there were no unusually brilliant displays reported, but the element of frequency affected quite prominently their appearance in the Northwest. The most important manifestation of auroral display was shown on the evening of the 18th by a somewhat remarkable continuity of observation extending throughout the Lake region and reaching in an unbroken line from Halifax, N. S., westward to the northwestern extremity of Montana. This line of observation was not a direct one, but assumed the form of an elliptical curve, the point of intersection with its minor axis coinciding very nearly with the geographical position of Chicago. Less extended but not entirely local displays, were witnessed as follows: 2nd, from stations in western Maine, northern New Hampshire, eastern New York, throughout Dakota, in western Montana and in Oregon and Washington Territory. In respect to the display in the two latter States a more extended notice is desirable. At Umatilla the aurora was visible from 8:50 to 10:20 p. m.; at 9 p. m. a small pale yellow light was visible in the N.N.E., increasing steadily in size until it assumed the form of an arch of about 20°, which occurred about 10 p. m.; thereafter until the close, bright luminous beams or flashes of reddish light shot upward toward the zenith, a distance of 35°. At Dayton, from 10 to 11:15 p. m., azimuth 180° to 205°, altitude 20°. 3rd, from Cape Breton Island, eastern New York, northern Minnesota, Dakota and western Montana. 20th, from southern Iowa northward to British America and westward to Dakota. 31st, from northern Iowa northward to British America and westward to Washington Territory. The following were local displays: Sidney, Cape Breton Island, 9th, p. m. Bangor, Me., 8th, a. m. St. Vincent, Minn., 23rd, 8:30 to 9:40 p. m.; 24th, 7 p. m. to midnight; 26th, 9 p. m. to midnight; 30th, 8 to 9:40 p. m. Spiritwood, Dak., 11th, p. m., 30th, p. m.

Zodiacal Light.—New Corydon, Ind., 22nd, 23rd; Clinton, Ia., 21st, 22nd, 23rd; Monticello, Ia., 20th, 21st, 22nd; Manhattan, Kan., 7th; Yates Center, Kan., 22nd, 23rd, 25th; Harvard College Observatory, Cambridge, Mass., 21st, 25th, 26th, 28th, slightly visible among clouds on the 24th; Somerset, Mass., 24th, 25th, 26th, 27th; Oregon, Mo., 16th, 17th, 25th, 29th, 30th; Bellefontaine, Ohio, 22nd, 27th, Wytheville, Va., 21st; Havana, Cuba, 17th to 19th, 22nd to 25th, 28th, 29th; Rochester, 10th; Nashville, 24th, 27th; New Haven, 25th.

Telegraphic Communication Interfered with by Atmospheric Electricity.—Ft. Grant, Ariz., 8th, peculiar electrical condition of the atmosphere, sufficient motive force to occasionally work instruments on the line between this station and Ft. Verde, although there was no battery attached. The galvanometer was constantly effected with an electro motive force of ordinary intensity which acted in a contrary direction to that usually displayed. Later in the day quantity of force increased, but intensity diminished between the two stations; finally current changed to opposite direction, followed soon after by a fluctuating quantity. La Mesilla, 5th; Jacksboro, Texas, 6th 9th, 11th; San Antonio, Tex., 24th; Laredo, Tex., 25th, discharges so heavy as to melt brass connections in office.

OPTICAL PHENOMENA.

Solar Halos have been observed in the various districts on the following dates: New England, 6th, 8th, 25th, 29th and 30th; Middle Atlantic States, 3rd, 6th, 8th, 10th, 12th, 15th, 16th, 19th, 21st, 22nd and 29th; South Atlantic States, 7th, 8th, 14th, 15th, 21st and 22nd; Eastern Gulf States, 13th, 25th, 27th, 28th and 30th; Western Gulf States, including Texas, 6th, 7th, 12th, 13th, 14th, 15th, 21st, 23rd and 29th; Ohio valley and Tennessee, 2nd, 7th, 11th, 12th, 14th, 18th, 21st, 23rd, 25th and 28th; Lower Lake region, 7th, 11th, 12th, 29th and 30th; Upper Lake region, 2nd, 7th, 9th, 10th, 11th, 27th and 29th; Upper Mississippi valley, 6th, 7th, 9th to 11th, 14th, 15th, 18th, 28th to 31st; Lower Missouri valley, 1st, 5th, 6th, 17th, 19th, 23rd, 27th to 31st; Rocky Mountain regions, 13th, 14th, 15th, 17th, 27th and 30th; Northern and Middle Plateau regions, 3rd, 4th, 8th, 9th and 25th; California, 2nd, 3rd, 4th, 9th, 18th, 23rd to 30th; Oregon and Washington Territory, 3rd, 10th, 11th, 17th, 20th, 22nd, 24th, 28th to 31st.

Lunar Halos have been observed in the various districts on the following dates: New England, 5th, 6th, 8th, 9th, 11th, 12th, 15th to 18th; Middle Atlantic States, 3rd, 6th, 8th, 10th, 11th, 14th, 15th, 16th and 26th; South Atlantic States, 6th, 7th, 11th to 15th; Eastern Gulf States, 6th, 7th, 9th, 11th, 12th, 14th and 17th; Western Gulf States, including Texas, 3rd, 4th, 6th to 8th, 11th 17th and 30th; Ohio valley and Tennessee, 2nd, 6th, 10th, 13th to 17th, 23rd and 27th; Lake region, 7th to 11th, 14th, 15th and 25th; Upper Mississippi valley, 3rd to 7th, 10th to 12th, 14th, 20th and 25th; Lower Missouri valley, 5th to 11th, 13th, 16th and 19th; Rocky Mountain regions, 6th, 8th, 9th, 12th, 14th to 19th; Southern Plateau, 6th, 7th, 8th and 11th; Northern Plateau, 6th, 8th, 10th, 11th and 22nd; California, 7th; Oregon and Washington Territory, 6th, 9th, 10th, 11th, 14th, 15th, 22nd and 24th.

Mirage.—Spiritwood, Dak., 5th, 8th, 19th and 26th; Genoa, Neb., 1st, 2nd, 3rd, 5th, 16th, 19th and 21st; Indianola, 4th and 8th.

MISCELLANEOUS PHENOMENA.

Sun Spots.—The following record of observations, made by Mr. D. P. Todd, Assistant, has been forwarded by Prof. S. Newcomb, U. S. Navy, Superintendent Nautical Almanac Office, Washington, D. C.:

DATE— March, 1861.	No. of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		REMARKS.
	Groups	Spots.	Groups	Spots.	Groups	Spots.	Groups	Spots.	
2, 8 a. m.	1	2	2	2	1	2	3	8	Faculae. Spots probably disappeared by solar rotation.
5 p. m.	0	0	0	0	0	0	3	8	
4, 2 p. m.	0	0	1	3	0	0	1	1	Faculae.
5, 8 a. m.	0	0	0	0	0	0	1	1	Faculae.
6, 10 a. m.	0	2	0	0	0	0	1	3	Faculae.
2 p. m.	0	0	0	0	0	0	1	3	
7, 9 a. m.	1	1	0	0	1	1	2	4	Broad areas of faculae.
8, 9 a. m.	3	8	0	0	2	7	5	12	Broad areas of faculae.
1 p. m.	0	0	0	0	0	0	5	12	Broad areas of faculae.
10, 4 p. m.	0	23†	0	0	0	0	5	35†	Faculae. Many of the spots small.
5 p. m.	0	0	0	0	0	0	5	35†	
11, 9 a. m.	0	10	0	0	0	0	5	45†	Faculae. Many of the spots small.
11 a. m.	0	0	0	0	0	0	5	45†	
13, 1 p. m.	2	15†	0	0	0	0	5	50†	Faculae.
14, 8 a. m.	2	20†	0	0	1	10†	7	85†	Faculae.
15, 9 a. m.	0	0	0	0	0	0	7	85†	Faculae.
16, 9 a. m.	0	0	0	0	0	0	6	85†	Faculae. Many of the spots small.
4 p. m.	0	0	0	0	0	0	6	85†	
20, 10 a. m.	1	1	0	0	0	0	3	40†	Faculae.
21, 3 p. m.	2	5	0	0	0	0	5	45†	Faculae.
22, 10 a. m.	0	15	0	0	0	0	4	60†	Faculae.
3 p. m.	0	0	0	0	0	0	4	60†	Faculae.
23, 8 a. m.	0	5	0	5	0	0	4	60†	Faculae.
24, 6 a. m.	0	0	1	10	0	0	2	40†	Faculae.
25, 5 p. m.	0	0	0	20†	0	0	2	15	
27, 8 a. m.	1	2	2	15	1	2	1	2	Faculae.
28, 7 a. m.	1	1	0	0	0	0	2	5	Faculae.
30, 12 m.	0	2	0	0	0	0	2	5	Faculae.

† Approximated.

Mr. William Dawson, at Spiceland, Ind., reports: 7th, two groups, three spots, one north of centre, two little spots and faculae at east edge; 9th, five groups, 65 spots; 10th, five groups, 78

spots; 14th, eight groups, 75 spots; air very poor, condensed group of 20 prominent spots near east edge; 15th, eight groups, 133 spots, a row of groups north and one south of the equator, air very good; 17th, six groups, 65 spots, air rather poor; 24th, two groups, 28 spots, one group $3\frac{1}{2}$ minutes from west side edge, the other nearly north of centre; 26th, two groups, four spots, two spots in each group, faculae at east edge; 27th, two groups, 7 spots, all new and gathering at east edge, air good, one group probably vanished before reaching west edge.

Mr. H. D. Gowey, at North Lewisburg, Ohio, reports: observed sun spots on the following dates: 7th, 9th, 10th, 15th, 17th, 18th, 23rd to 25th, 28th.

Sunset.—The characteristics of the sky at sunset, as indicative of fair or foul weather for the succeeding twenty-four hours, have been observed at all Signal Service stations. Reports from 176 stations show 5,371 observations to have been made, of which 25 were reported doubtful; of the remainder 4,613 or 85.9 per cent. were followed by the expected weather.

Earthquakes.—Bainbridge Island, Wash., Ty., 14th, 10.30 p. m., motion slightly tremulous, duration 30 seconds. Hebron, Utah, 25th, about 7 p. m., slight shock. Pioche, Nev., 7.30 p. m., shaking brick buildings and rattling crockery and glassware.

Meteors.—None of any particular importance have been reported during the month, although there was no lack of the usual degree of watchfulness on the part of observers.

Prairie and Forest Fires.—Creswell, Kan., 15th, 23rd to 31st; Dodge City, 27th; Ft. Gibson, 1st, 2nd, 7th, 9th, 12th, 19th, 20th, 24th, 25th, 27th, 29th, 30th; Eagle Pass, Tex., 4th.

Polar Bands.—New Corydon, 2nd, 7th, 23rd; Yates Centre, 5th, 19th, 29th; Portland, Or., 7th; Prescott, Ariz., 4th.

Sand Storms.—Ft. Yuma, Ariz., 2nd, 8th, 13th, 14th; Umatilla, Or., 23rd, very violent, followed by rain, with thunder and lightning and a wind-velocity of 42 miles from the west; Socorro, N. M., 2nd, 13th; Albuquerque, N. M., 2nd, 31st; Camp Thomas, Ariz., 2nd, 3rd, 6th; La Mesilla, N. M., 10th, 13th; Ft. Cummings, N. M., 6th, 13th.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

H. B. Weym

Brig. & Bvt. Maj. Gen'l,
Chief Signal Officer, U. S. A.

Copy furnished for

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WAR DEPARTMENT WEATHER

SIGNAL SERVICE, U. S. ARMY
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF



No. I.

WEATHER MAP.
U. S. ARMY.
BENEFIT OF COMMERCE AND AGRICULTURE.



AREAS OF LOW BAROMETER FOR MARCH, 1881

BY ORDER OF THE SECRETARY OF WAR

W. H. Murray
MAJ. GEN'L, CHIEF SIGNAL OFFICER, U. S. A.

NOTE.—The Roman letters show number and order of areas of low barometer. The figures above the lines show the days of the month; those below, 1, 2 and 3, indicate respectively the 7 A. M., the 3 P. M., and 11 P. M., (Washington mean time,) observations. The small circles on the lines indicate the position of the centre of the area of low barometer on the day and report, written respectively above and below the line.

SIGNAL SERVICE, U.S.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT
ISOBARS, ISOTHERMS AND PREVAILING



TEMPERATURE OF WATER
MARCH, 1961

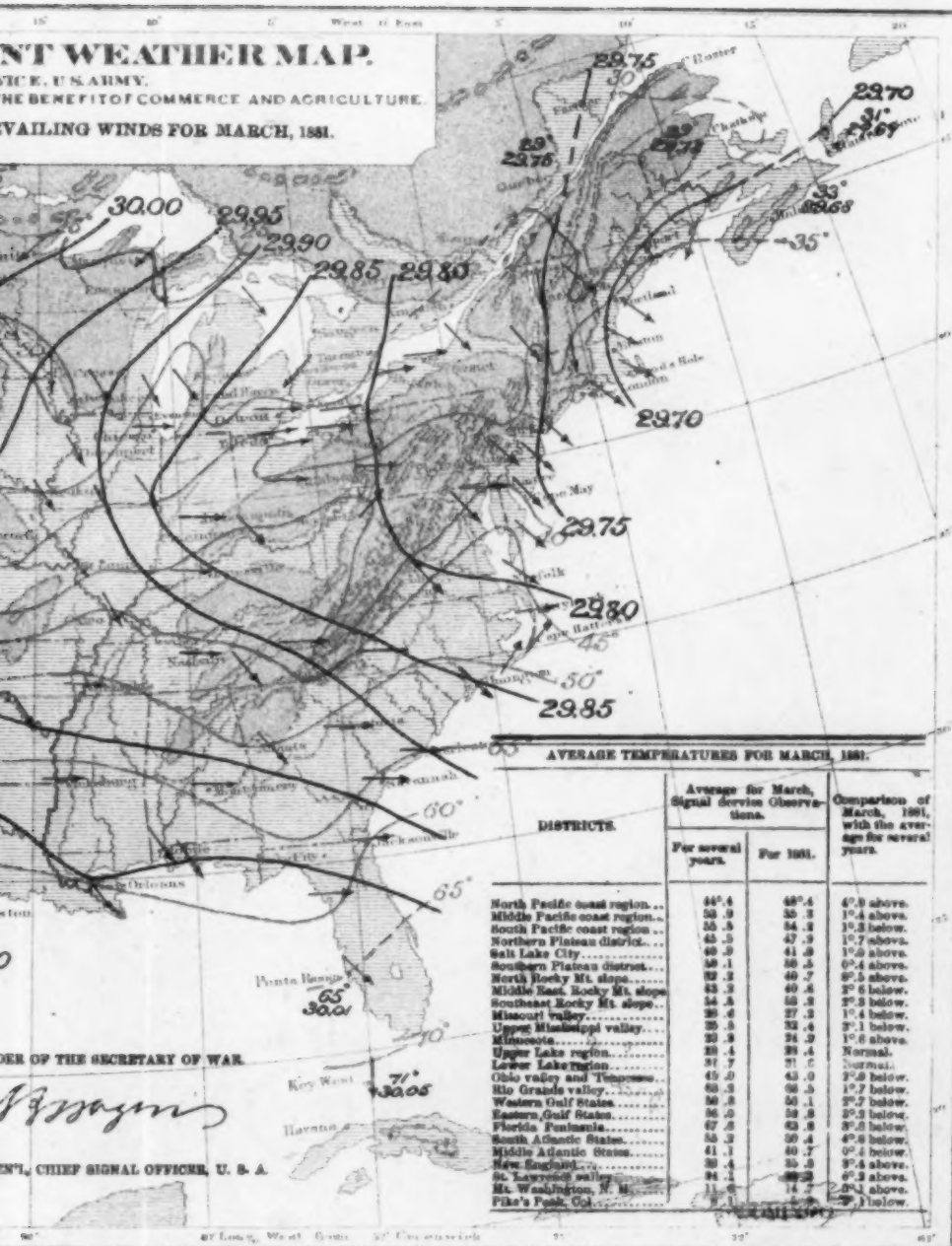
STATIONS.	Temperature at bottom.		Average depth, fathoms.
	Max.	Min.	
Alpena.....	59°	49°	11
Ashtabula.....	59°	49°	11
Baltimore.....	41	34	11
Belfast.....	54	38.5	11
Burlington.....	57	53	11
Cedar Key.....	58	55	11
Charleston.....	57	55	11
Chicago.....	52	37	11
Chillicothe.....	57	55	11
Cleveland.....	54	53	11
“Detroit.....	54	53	11
Duluth.....	54	53	11
Ed. Brackley.....	54	53	11
Eastport.....	54.5	52.5	17
Genoa.....	57	55	11
Galveston.....	55	50.5	14
Grand Haven.....	57	55	11
Jacksonville.....	59	56	10
Key West.....	79	60	10
Marquette.....	57	55	11
Milwaukee.....	57	55	11
“New.....	61	56	14
New London.....	49	34	17
“New York.....	49	34	17
North.....	51	45	23
Portland, Maine.....	57.5	51.5	26
Rockland.....	57	55	11
“Sandy.....	52	50	10
San Francisco.....	57	55	11
Savannah.....	55	50	10
Smithville.....	56	53	14
Toledo.....	50	39	14
Wilmington.....	57	55	11
Wood’s Holl.....	60.5	53	11

* Observations for only part of month—see text.

ANT WEATHER MAP.

OFFICE, U. S. ARMY.
FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

PREVAILING WINDS FOR MARCH, 1881.



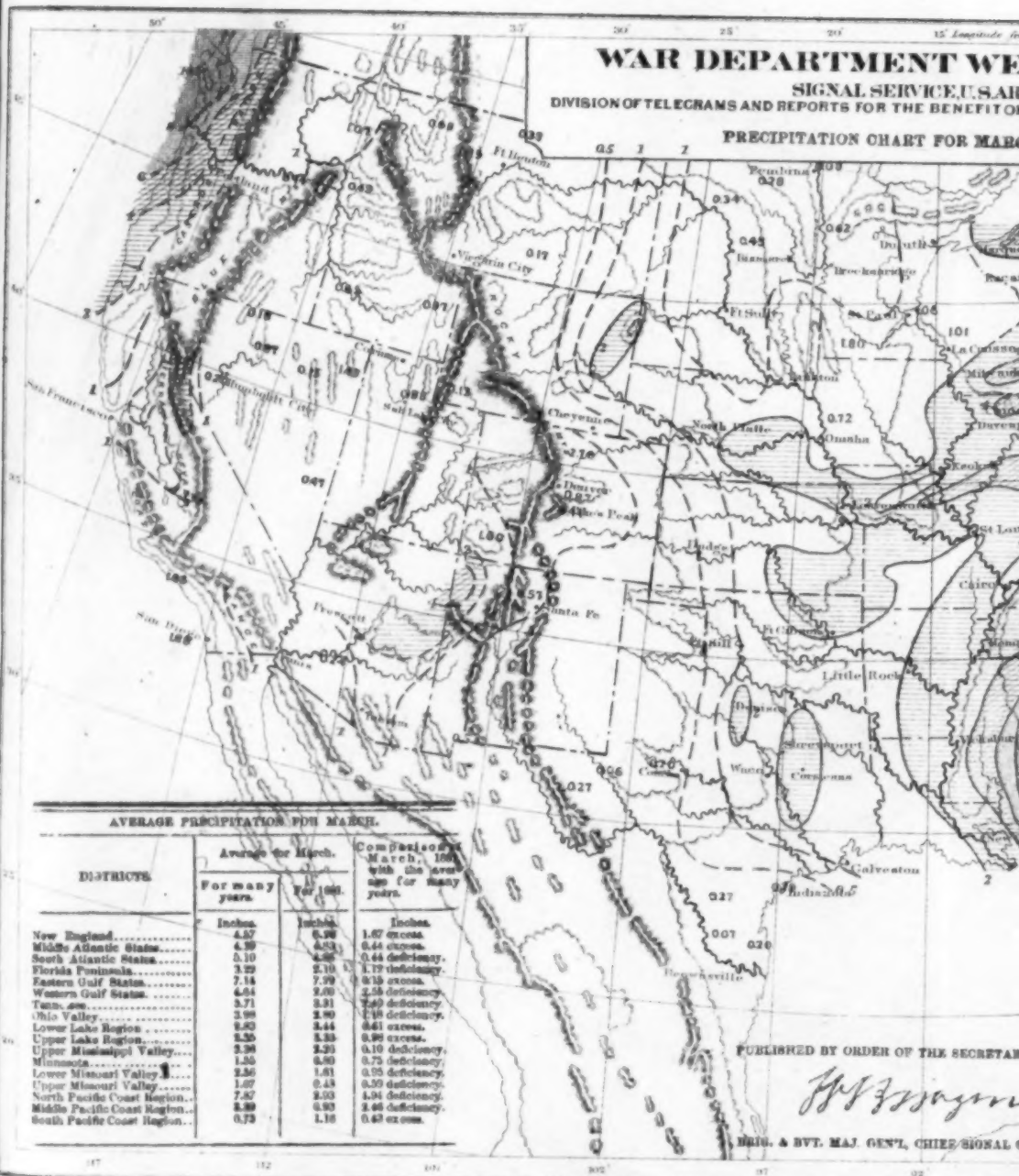
AVERAGE TEMPERATURES FOR MARCH, 1881.

DISTRICTS.	Average for March, Signal Service Observations.		Comparison of March, 1881, with the average for several years.
	For several years.	For 1881.	
North Pacific coast region...	44.4	48.4	4.0 above.
Middle Pacific coast region...	50.9	50.3	0.6 below.
South Pacific coast region...	55.5	54.3	1.2 below.
Northern Plinian district...	45.5	47.3	1.8 above.
Salt Lake City...	40.9	41.9	1.0 above.
Southern Plinian district...	50.1	50.3	0.2 above.
North Rocky Mt. slope...	42.3	40.7	1.6 above.
Middle East, Rocky Mt. slope...	43.3	40.3	3.0 below.
Southeast Rocky Mt. slope...	54.3	50.3	4.0 below.
Missouri valley...	30.6	27.3	3.3 below.
Upper Mississippi valley...	35.3	32.4	2.9 below.
Minnesota...	30.3	31.3	1.0 above.
Upper Lake region...	30.4	30.4	Normal.
Lower Lake region...	31.7	31.7	Normal.
Ohio valley and Tennessee...	45.0	43.0	2.0 below.
Rio Grande valley...	40.3	38.3	2.0 below.
Western Gulf States...	50.0	50.1	0.1 below.
Eastern Gulf States...	56.0	52.8	3.2 below.
Florida Peninsula...	57.5	53.8	3.7 below.
South Atlantic States...	55.3	50.4	4.9 below.
Middle Atlantic States...	41.1	40.7	0.4 below.
New England...	30.4	30.3	0.1 above.
St. Lawrence valley...	34.1	30.3	3.8 below.
Mt. Washington, N. H....	11.0	14.7	3.7 above.
Pike's Peak, Col....	7.1	7.1	Normal.

ORDER OF THE SECRETARY OF WAR.

CHIEF SIGNAL OFFICER, U. S. A.

WAR DEPARTMENT
SIGNAL SERVICE, U.S.A.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF
PRECIPITATION CHART FOR MARCH



WEATHER MAP.
U.S. ARMY.
IN BENEFIT OF COMMERCE AND AGRICULTURE.
FOR MARCH, 1891.

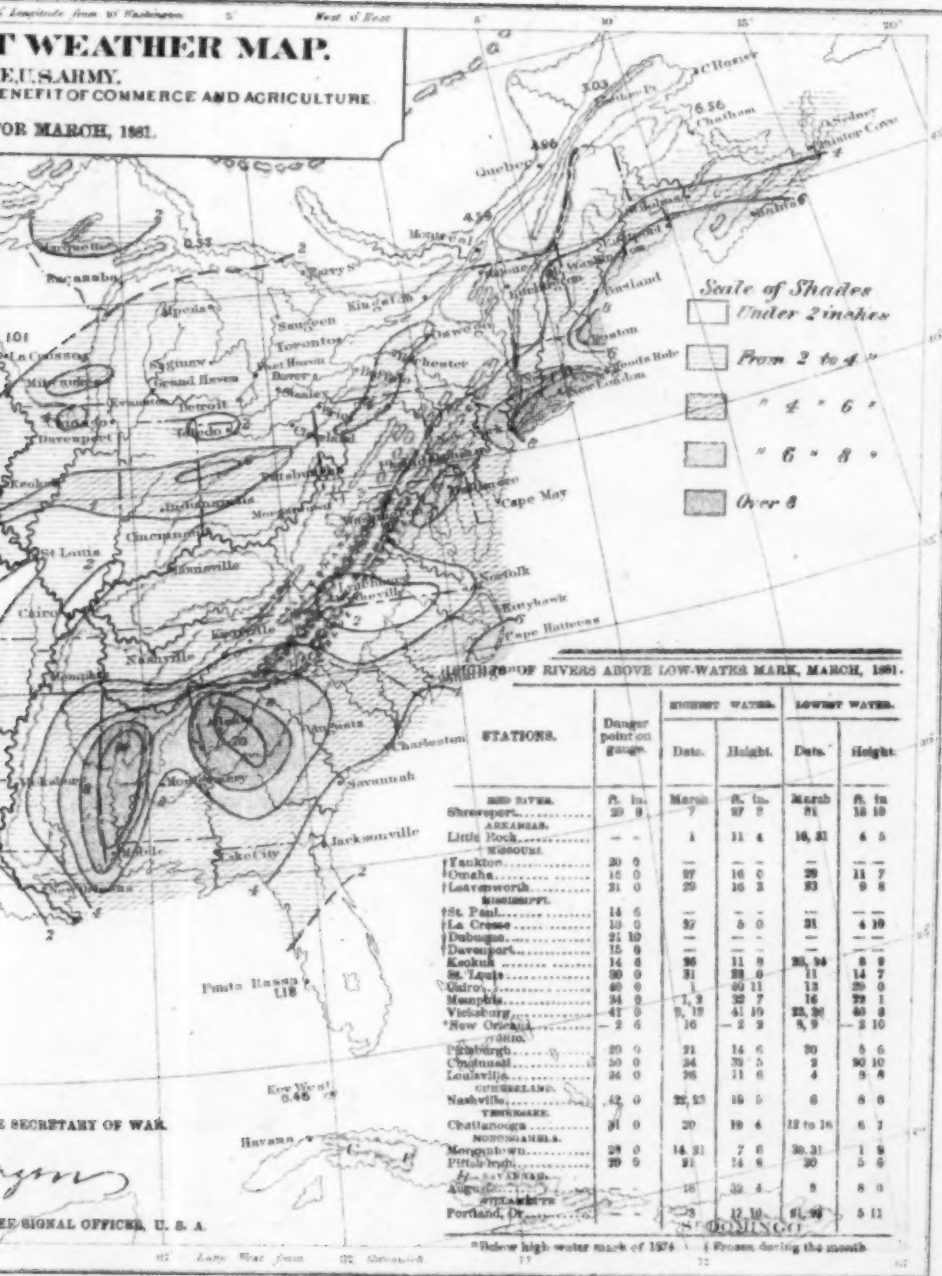


CHART No. IV.

INDEX TO STORM-TRACKS.

- | | | |
|-----|------|---------------------------|
| No. | 1. | From Feb. 1 to 2, 1881. |
| | II. | From Feb. 3 to 7, 1881. |
| | III. | From Feb. 8 to 12, 1881. |
| | IV. | From Feb. 13 to 18, 1881. |
| | V. | From Feb. 19 to 23, 1881. |
| | VI. | From Feb. 24 to 28, 1881. |





INTERNATIONAL METEOROLOGY—OCEAN STORM-TRACKS
PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Broken or dotted lines indicate that the lines so broken are doubtful.

Arrows, when charted, fly with the wind and exhibit wind-direction.

The tracks charted in black have appeared in previous *Reviews*.

The tracks charted in red have been made from data collected since preceding *Review*.

H. H. H. H. H.

CHIEF SIGNAL OFFICER, U. S. A.

**Office of the Chief Signal Officer,
UNITED STATES ARMY.**
Charted from Actual Observations taken Simultaneously, Series commencing January, 1877.

No. V.





CHIEF SIGNAL OFFICER, U. S. A.

ISOBARS AND ISOTHERMS.
Isobars in blue; detached barometer means in English inches.
Isotherms in red; detached temperature means in degrees Fahrenheit.
Broken lines, are doubtful.

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